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THE AMERICAN GEOGRAPHICAL SOCIETY

THE American Geographical Society is the oldest geographical society in the United States. Its objectives since the foundation in 1852 are to collect and disseminate geographical information by discussion, lectures, and publications; to establish in the chief city of the United States a place where may be obtained accurate information on every part of the globe; and to encourage such exploring expeditions as seem likely to result in valuable discoveries in geography and the related sciences.

The Society publishes the *Geographical Review*, a quarterly magazine issued in January, April, July, and October, and a series of *Special* and *Research Publications* of comprehensive scope. The library is one of the largest geographical libraries of the world; in addition to the usual functions it maintains a Research Catalogue and issues the periodical *Current Geographical Publications*. Besides its modern cartographical material the Society possesses a valuable collection of atlases of the sixteenth, seventeenth, and eighteenth centuries. Travelers, men of science, and others properly accredited are welcome at the rooms of the Society and may freely use the collections.

Four gold medals are awarded by the Society: the *Cullum Geographical Medal*, the *Charles P. Daly Medal*, the *Samuel Finley Breese Morse Medal*, and the *David Livingstone Centenary Medal* (founded by the Hispanic Society of America).

The Society has also for many years promoted studies relating to questions of wide public interest; for example, settlement in the pioneer belts of the world, the problem of the white man in the tropics, the bearing of geography on international relations, the historical geography of the United States, polar exploration and geography. The Society is also engaged in the development of new techniques and instruments designed to increase the efficiency and reduce the costs of surveying and mapping; and it has long been at work on a great standard map of the Americas from the Mexico-United States border to Cape Horn. This map, in 107 sheets, which is now completed and under revision, is a project of direct utility to scientists, businessmen, and government officials concerned with Latin America.

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The Geographical Review

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Geography in This Crowded World

WITH striking frequency the crises of man's existence have been met and solved by forces seemingly created to await in obscurity the circumstantial moment that would call them forth to their supreme test. At least the shadow of a parallel can be found today as geography rises to cope with the approaching struggle between increasing world population and fixed or diminishing world resources. Geography, one might almost say, has been lying in wait for this moment.

Humanity has reached the point, in its long journey toward maturity, where it now makes demands, not upon the resources of a region or of a continent, but upon the productive capacity of the entire earth. World population, which doubled in the last century, is expanding by giant leaps. Food production in the more crowded areas is insufficient to feed the contained groups, and the mass movement of foods from the abundant areas of the earth into the crowded sectors has been organized on a permanent basis. Lands that even recently were slated for withdrawal from cultivation are being put back into forced production, and no country can honestly say that it is banking its resources for the future.

Hunger is not new to the world, for starvation areas have always existed. Formerly relief was obtained by migration into new and undeveloped areas—there was always somewhere to go, and the settlers of a new land usually welcomed followers. A principal task of the modern period of settlement has been to report on the new lands discovered by exploration, and to inform correctly the groups about to set forth toward them. Geography was the service arm of the great movements of civilized man about the earth. The movement of people to new lands has now slowed almost to a halt. Lesser adjustments continue, to correct errors or in answer to the changes of technocracy, but the main effort is over. The world is all but filled, title determined, "welcome" signs down, the land strictly posted against further trespass.

What comes next? The movement of food to people. The transportation

of perishables is approaching perfection. Bananas come out of the tropics in floating incubators; the citrus fruits travel in refrigerated cars from their home in the subtropics to the zone of the hard winters or jump across the equator to beat the seasons; grains are moved dry, and livestock on the hoof. Preservation becomes important, to halt the ripening (or deteriorating) process, either as an aid to transportation or for storage into the lean seasons. The resources of the entire earth are thus brought into direct and usable relationship with the inhabitants of the entire earth.

What *now*? Man is a determined and possessive animal. Will he run through the visible supply of his resources in reckless disregard of the aftercoming generations, counting on their ingenuity to wiggle out of the tough spots in which they may be left? Will nations deliberately overpopulate, to justify their "right" to a larger share of the earth's area, or to stock-pile a consumable product in case of war? Will the crowded nations, unable longer to maintain or resettle their excess humanity, persuade their more moderate neighbors to break into their agricultural savings and distribute largess out of blind pity? These things are possible, and, in the consternation of the first view, they seem likely enough to happen.

Whatever steps may be taken to prevent or mitigate this "final exploitation, the spiralling draft upon the world's resources," they must be taken with a sharp awareness of the *many* elements that contribute to the life and livelihood of man, not simply one or two. The list is long, and therein lies the danger of failure. We have, for example, the physical sciences—geodesy, geophysics, geology, geomorphology, hydrography, oceanography, glaciology, meteorology, climatology. Can any of these be left out? Indispensable, too, are the natural sciences—pedology, botany, forestry, agriculture, zoology, anthropology, ethnography, ecology, demography, medicine. But man's actions and reactions lie deep at the core of the matter; therefore the social sciences—linguistics, history, political science, military science, regional planning, sociology, economics. Important all, but so large in number and in scope as to deaden the comprehension. What usable form can they be given? Mere summation of the parts produces little more than confusion. Clearly, these complex elements must be so handled that the result is an integrated and purposeful answer to the question of man and the land. No one by declaration can furnish this answer. It hinges upon a workable method.

Geography appears to possess that method. Once merely a descriptive science, geography has advanced to the infinitely more difficult task of analyzing as a whole the elements that distinguish place from place, and from

there into synthesis of earth patterns. "We have the unique ability to see patterns," writes Wilson. "We must recognize our primary interest as being the discovery, identification, analysis, and synthesis of earth patterns." And vital to the method is that master tool, geography's perfection, the map.

Speed is essential. We cannot wait for history to develop its predictions from parallel situations—there is no parallel for a crowded world. Fortunately, the method of geography is not based so much upon historical precedent as it is upon induction and deduction, the only way in which related facts can be extracted from available materials to yield a contemporary view. Although history and geography often deal with the same materials, one might say that they constitute the two coordinates expressing the existence of man, history being the long view and its axis time, geography the broad view, the instantaneous view sideways as we drop down through time.

The seriousness of the emergency has been disputed. Vogt's warning has been answered by agriculturists who point the way to higher yields per acre of soil. Yet gains in yield mean only postponement, not victory; for in the long run the creature of biology absorbs all that botany has to give, and if that creature is man with his tools of cultivation, he may end up by stripping rather than increasing the productive capacity of the earth. The time to meet the challenge is now, and it is not too late.

Much work has already been done by geographers on the elucidation of earth patterns and their meaning for mankind. Gillman's "Vegetation-Types Map of Tanganyika Territory" is an example; it is a step toward the goal of determining the conditions for harmony between man and his supporting environment in East Africa. McBride's "Land Systems of Mexico" offers another apt example, for does not the ownership of land stand squarely at the center of the problem? But the work McBride has done for Mexico and also for Chile needs to be carried further and extended to the rest of Latin America and to other lands as well. Too often in geography the work has been of a sampling or demonstration nature, without the power to continue after the pilot attempt. Consecutive studies toward a directed goal, as pursued by Bowman and Sauer, are exceptions.

The Society believes that the development of the basic framework of geographical research in America ranks in importance with any of the other great research programs of the era. We are now engaged in exploring the possibilities of programs of continuing research. Several policy-making discussions were held during the past year, and a progress report will be rendered at the Annual Meeting of the Society in January. RICHARD U. LIGHT

Man and the Land and the Third Freedom

"Freedom from want" is a way of defining the goal of the "Road to Survival," the resultant of the fundamental equation resources/man. On this criterion William Vogt finds Africa the poorest of the continents. "It possesses the lowest carrying capacity per square mile"; nearly all of it "is marginal for agriculture." In other words, the renewable resources of Africa are most seriously in need of conservation. "One of the best clues to lands suitable for man's use," says Mr. Vogt, "is given by the native vegetation." The value of this clue has been attested by the Society's pioneer study "The Vegetation and Soils of Africa," by H. L. Shantz and C. F. Marbut. Their book, published in 1923 and long out of print, is still in demand. The need now is for newer and more detailed studies, such as Clement Gillman's vegetation-types map of Tanganyika Territory. With his unrivaled knowledge of the country, Mr. Gillman was acutely aware of the "ecological imperatives" and of the need for informed "ecological trusteeship" in a land where the ecological balance is of the utmost delicacy. What happens when the balance is disturbed—by the introduction of such a new mode of land utilization as groundnuts cultivation, for instance? The question whether the much publicized groundnuts scheme is "sound—or dangerous" is being asked by many well-informed persons, recently by Dr. H. E. Desch in the *Crown Colonist* (Nov., 1948). Each new project undertaken in the tropics reveals the extent of our geographical ignorance. In his address to the British Association last September, Lord Rennell, speaking on "Social Geography with Special Reference to Africa," singled out Clement Gillman as an outstanding example of the pioneer in colonial geography.

Out of Africa Something New

Put Fairfield Osborn's "Our Plundered Planet" alongside "Road to Survival," and you have two books by scientists written in language that everyone can understand: no one, therefore, should be unaware of the world's dilemma—the wastage of our renewable resources. Casting further light, sometimes of a critical nature, on the arguments of these prophets of "doom unless . . ." is a large and fast-growing literature. Our survey of some recent examples is far from exhaustive, but it does suggest the complexity of a problem that involves the total environment everywhere. And in the reviews section J. Russell Smith adds his forceful word on the natural-resources situation in countries about the Caribbean. There is Mexico, where the rate of population increase,

The World's Dilemma

having become one of the most rapid in the Western Hemisphere, creates an urgent situation. The complexity of this situation is implicit in Henry Sterling's analysis of "Rural Mexico"—the need for understanding a total environment in which man himself is the most complicating factor.

China: Land of Famine

We are especially grateful to Mr. Vogt for his chapter entitled "As Mankind Thinketh," a warning against confusing the verbal and the actual, the ideological name and the thing itself. As an example he cites the confusion over "land," which "partially explains why thousands of unfortunate refugees are being dumped into tropical countries that do not have nonverbal land capable of feeding their own people." Or take the case of China's Far West: the sparseness of population in Sinkiang, only six to the square mile, seems a direct invitation to the teeming millions of the Great Plain. So it is regarded by many Chinese officials, but Chang Chih-yi, who has investigated the possibilities of land utilization and settlement in Sinkiang, demonstrates that if *natural resources* is substituted for *area* in the population/area ratio the land is already well filled. Internal colonization is not to be looked upon as a solution for overpopulation in the East. Must we then find with the Neo-Malthusians a "grim satisfaction" in the flood and famine checks that still take their toll from China's people? UNRRA thought differently when it undertook the restoration of the Yellow River to the channel from which it was diverted in 1938 and thus reclaimed two million acres of good farmland. Oliver J. Todd, who probably knows more about the Yellow River than any other living engineer, directed the work to successful completion in spite of difficulties created by the civil war. He too envisages the far larger program needed for permanent relief from the threat of flood and famine, in which program economic, political, and social causes of disaster must also be overcome, as Walter H. Mallory so effectively pointed out in the Society's "China: Land of Famine." His concluding paragraph on overpopulation is as trenchant a statement as any in "Road to Survival" or "Our Plundered Planet."

So Many People, So Little Land

The most pressing single problem in Japan is food production. As we note elsewhere, Lieutenant Colonel Hubert G. Schenck, chief of the Natural Resources Section of SCAP, emphasizes the need for long-range planning: "Indifference toward national economic planning is a luxury Japan can ill afford, but Japanese science and technology have never been in a position to attack the problem on a practical basis." This is particularly true of the country's fisheries, the principal source of animal proteins in the Japanese diet. In "A Program for

Japanese Fisheries" Ada Espenshade focuses attention on "the problem of providing as much protein food as possible for the Japanese—in the long-range future as well as in the immediate future."

"Bandit" Nature exacts a toll from political man. On a large scale or small he stakes out arbitrary limits to his own particular sphere—and pays for it.

Boundary Troubles

Within a single boundary Idaho contains two distinct and separated terrains, north and south; the outlooks of the users of those terrains are different also. In conflicts of interests over such matters as taxes, institutions, and highways the people of the state are paying for Nature's sectionalism.

For geographers the concept of total and constantly changing environment is of deepest significance. Every aspect of form and process is a subject for study.

In the Last Analysis

Meltwater sapping of the headwall of a cirque has its effect on the total environment no less than erosion of loess and deposit of silt in the Yellow River delta; the creation of nivation hollows by chemical weathering in the Cascades is as much a geographical fact as the formation of alkaline soils in the deserts of Tarim. Gordon Manley has no doubt about the final importance of the work of snow and ice in the total environment. "For around the North Atlantic the extent of the ice is ultimately far more significant than a few peevish politicians with such playthings as bombs!" The last word is the Earth's. It was a Chou philosopher who said, "There is no bandit so remorseless as Nature."

G. M. W.

A VEGETATION-TYPES MAP OF TANGANYIKA TERRITORY

CLEMENT GILLMAN†

To know what is, is vital for discussing
what ought to be.

The manuscript map and text were received at the American Geographical Society in November, 1946, a month after the death of the author. He died while flying from Dar es Salaam to Moshi, engaged, as ever, in "making notes on the journey." The January, 1947, number of the Geographical Review *contained a brief appreciation of the work of Clement Gillman, of whom a contemporary said, "In a sense he* was *Tanganyika."*

The map crowns a career devoted to geography and East Africa—to vanquishment of "splendid ignorance" by unassailable facts. But if Gillman was constantly warring against the legend or obsession of "Africa's untold wealth," his efforts were in themselves constructive; he sought to lead to a "sounder optimism based on the search after knowledge which sees hope for Man, even in semi-arid Africa, through his adapting himself to an inexorably stern Nature without further wanton destruction, by learning and facing the facts."

THIS map has been a long time in the making. The author began the purposeful accumulation of material in 1913 and continued during all his surveys in the Territory. The publication of his population map of Tanganyika in the *Geographical Review* in 1936 gave him the urge to assemble the vegetational data, and further stimulus came in 1940 when an Interterritorial Pasture Research Conference at Nairobi appointed a committee to draw up a classification of East African vegetation types. By the end of 1943 the plan had been formulated, and the author was entrusted with the preparation of the map for Tanganyika Territory. To do justice to the large amount of available source material, a first draft was executed, in 1944–1945, on the scale of 1 : 500,000 in 25 sheets or part sheets of the standard size of 4° squares. It was hoped to publish the final map on the millionth scale; meanwhile, for practical reasons, the scale was reduced to 1 : 2,000,000 (Pl. I, facing p. 36).

The Classification Committee's draft report of July, 1943, stated:

> We set out to classify vegetation by vegetation and not by anything else that may or may not be closely correlated with it. In leaving out questions of successional status we classify vegetation not by what it perhaps used to be, nor by what it will become according to some current theory, but by what the surveyor finds.

In other words, the classification and the map built thereon are strictly physiognomic. Within the limits of scale and reliability the map provides the essential factual basis for further ecological and geographical investigations, as well as for checking the tenability of theories derived from classifi-

cations. This is all the more desirable in a region where comparatively recent and often large-scale differential movements of the earth's crust have resulted in a highly variegated pattern of dovetailing geological, climatic, edaphic, and hydrological conditions, changing frequently from place to place and often imperfectly known. Thus this conscientious mapping of the directly observable physiognomic vegetation types will, it is hoped, increase our knowledge of such less easily observable features as climate, soils, and, to a certain extent, subsurface hydrology, the least known of all.

Difficulties of Compilation

To enable the reader to gauge the usefulness of the map for his particular purpose, some of the difficulties inherent in its compilation must be briefly mentioned. Although the most recent topographical maps used for plotting the vegetation are distinct improvements over the older editions, they are uneven in quality and in parts can only be styled "rough approximations."[1] Our knowledge of the vegetation itself is likewise patchy, and the areas on the map that are based on a proper, *ad hoc,* vegetation survey are regrettably few and small. However, a careful scrutiny of the available source material has permitted the attaching of relatively "high reliability" to about 55 per cent of a map that can, and does, claim only reconnaissance status. Where land poorly known vegetationally is surrounded by better-known areas possessing identical topographical features, topographical interpolation was thought permissible. Such regions and others for which only older observations exist were classed as of "medium reliability"—about 25 per cent. The rest of the map, even though mere intelligent guesses are few, can claim only "low reliability" (20 per cent).

In a country where shifting of population often leads to marked changes in population density within comparatively short periods of time, one must beware of accepting vegetational observations made 20 or 30 years ago without a check, which, admittedly, has not everywhere been possible. The author knows of many large tracts of land formerly intensively cultivated that have reverted to bush or woodland, and forests and woodlands that have recently disappeared, or are in process of disappearing, under the onslaught of man and his fires. If checks can be made, there may be the difficulty, perhaps more apparent than real, of fitting the old terminology into the new, especially if the earlier observer was a layman with his own peculiar glossary. Furthermore, the personal equation enters in; and subjective in-

[1] Aerial mapping of large areas in Tanganyika Territory is in progress. See "Mapping the Colonial Empire from the Air," *Crown Colonist,* Vol. 18, 1948, pp. 357-361.—Edit. Note.

terpretation is intensified by the fact that the more open African grassy woodlands or wooded grasslands change in their physiognomic aspect with the season.[2] Finally, due consideration must be given to the unavoidable difficulty of deciding what to omit among even well-known factual features during the process of reduction to a map scale that does not permit the use of all available material.

Vegetation Types

The vegetation of the greater part of Tanganyika Territory belongs to the intricate mixture of wood- or bush-land with grassland characteristic of the tropics with alternating dry and wet seasons. The distribution of these two competing elements within a climate ranging from semihumid to semi-arid is primarily determined by edaphic variations of soil and hydrological conditions and by the use, or misuse, that man makes of them. Small parts of the Territory lie in climatically or edaphically more humid or more arid regions, so that any classification intended to cover the whole range of observable types must include evergreen forests and deserts. In deciding on the nomenclature the Classification Committee has rightly given preference to plain English words, has avoided unnecessary tautologies such as "ever-green rain forest," and has strictly abstained from the use of such terms as "savanna," "steppe," and "veld," since legitimate doubt may arise as to whether such importations from the languages of lands harboring their prototypes are correctly used out of their proper setting. Similarly, East African vernacular words, such as *miombo* and *nyika*, have been avoided.

The scheme adopted shows eight main physiognomic vegetation types: (1) Forest, (2) Woodland, (3) Bushland and Thicket, (4) Wooded Grassland, (5) Grassland, (6) Permanent Swamp Vegetation, (7) Desert and Semidesert, (8) Vegetation Actively Induced by Man.

During the compilation of the map it became necessary to introduce two intermediary types in order to fit in observational facts, one between (1) and (2), the other between (2) and (3/4). The many subtypes listed had to be practically ignored, either because their distribution was far from sufficiently known or because, where known, it could not be represented on a small-scale map. For Grassland and Induced Vegetation only, two major subtypes in each were considered essential to bring out interesting features, and under Thickets three geographically or economically important sub-

[2] See, for example, the picturesque description of the *miombo* woodland in B. D. Burtt: Some East African Vegetation Communities, edited by C. H. N. Jackson, *Journ. of Ecology*, Vol. 30, 1942, pp. 65–146; reference on pp. 73–74.—Edit. Note.

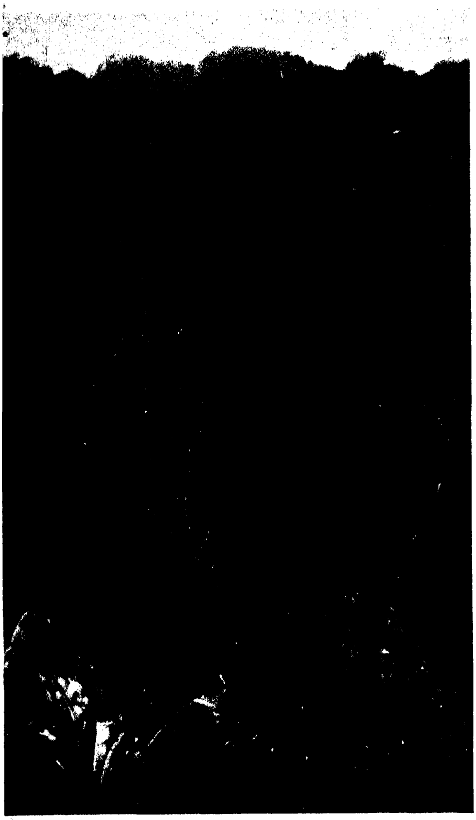

FIG. 1

FIG. 2

FIG. 1—Rain Forest, western Mporoto Mountains (33° 25′ E., 9° 5′ S.). (Longitudes and latitudes are approximate.)
FIG. 2—Fringing Forest, upper Pangani-Ruvu River (37° 30′ E., 3° 35′ S.).

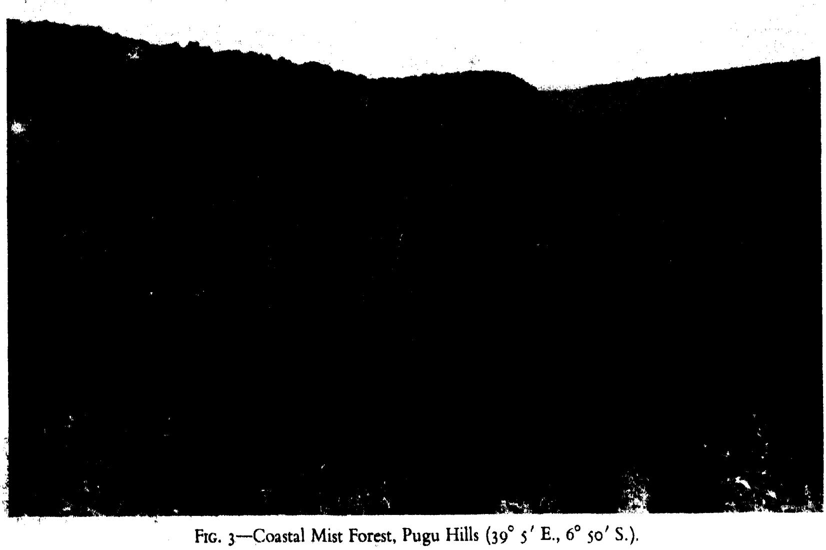

FIG. 3—Coastal Mist Forest, Pugu Hills (39° 5′ E., 6° 50′ S.).

FIG. 4

FIG. 5

FIG. 4—Forest-Woodland Intermediary type. Coastal hinterland peneplain, eastern Uzigua (38° 35′ E., 6° 5′ S.).
FIG. 5—Typical *Brachystegia* Woodland from the Plateau Catena, southwest of Tabora (32° 40′ E., 5° 30′ S.).

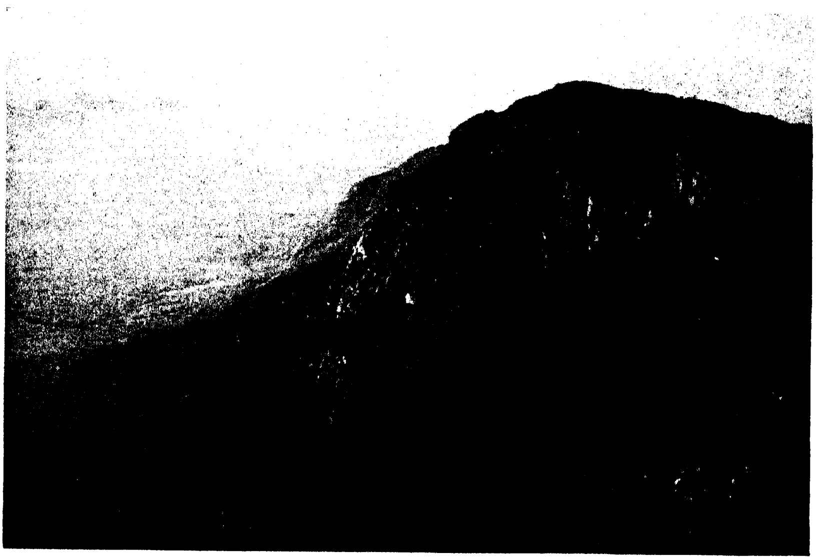

FIG. 6—Mist Forest remnant, northwest corner of high block of Usambara (38° 20′ E., 4° 30′ S.).

types of regional extent are shown separately. Inasmuch as this is a new classification, in many ways diverging considerably from old-established practice, it seems essential that a short description of the main types should be given, based largely on the Classification Committee's own definitions.

1. *Forests* are continuous stands of trees, many of which may attain a height of 50 meters or more, with crowns touching or intermingling, often freely interlaced with lianas. Epiphytes (orchids, ferns, and giant mosses) are frequent in the wetter types. The canopy usually consists of several distinct stories. Most of the trees are in full leaf the year round, but in some types deciduous trees dominate. The floor is either covered with herbs and shrubs (sometimes including carpets of cryptogams—ferns, *Lycopodium*, *Selaginella*) or bare where the tree canopy excludes light. Grasses, if present, are comparatively localized and inconspicuous. The main subtypes are rain forest; lowland and upland dry (or "mist") forest, the latter often clad in lichens; deciduous forest; ground-water and riverine fringing forest; and swamp forest, either fresh-water or saline (mangrove forest).

A characteristic physiognomic feature, especially of the drier upland types, is a fire-created grass and bracken land that eats into the edges of the virgin forest and, forming constantly growing grassy glades, tends to dissolve the forest; the penultimate stage of this process is a dominating grassland containing ever shrinking islands of gnarled forest remnants. The map attempts to bring out this characteristic and economically important and dangerous features by pale yellow patches inside the black forest areas and by black dots on the yellow of the surrounding grassland.

2. *Woodland* is land with an open cover of trees the crowns of which do not form a thickly interlaced canopy and which, as a rule, are leafless for some period in the year. Scattered evergreen shrubs may be present but are not conspicuous. Grasses and herbs form the dominant ground cover. Epiphytes are rare, though there may be lichens.[3] This type assumes such different forms floristically under the control of different combinations of the edaphic and climatic factors that probably the best subdivision will be according to dominating genera, such as *Brachystegia*, *Isoberlinia*, *Afrormosia*, *Acacia*, *Combretum*, and *Uapaca*. A subtype characterized by bamboo (*Oxytenanthera abyssinica*) thickets as a dominant ingredient is found throughout the large woodland area south of 8° S., and also on the high ground bordering the Lake Tanganyika trough on the east.

[3] The more important synonyms are *Steppenwald*, *Trockenwald* (Engler); "dry forest" (Shantz); "*Brachystegia* deciduous savannah forest" (Henkel); *Savannenwald* (Schimper); *Buschwald* (Vageler); "open woodland" (Tansley and Chipp).

FIG. 7

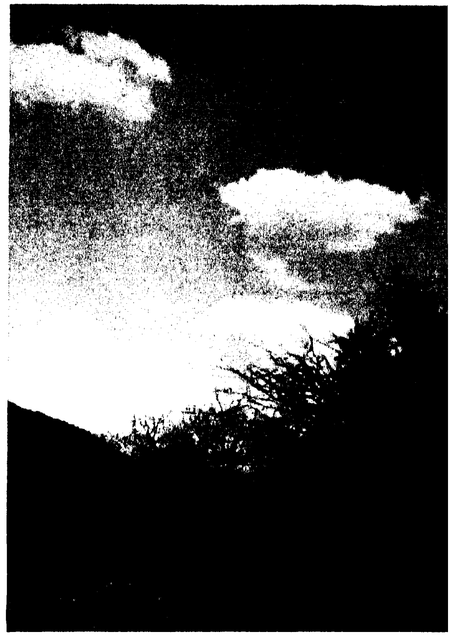

FIG. 9

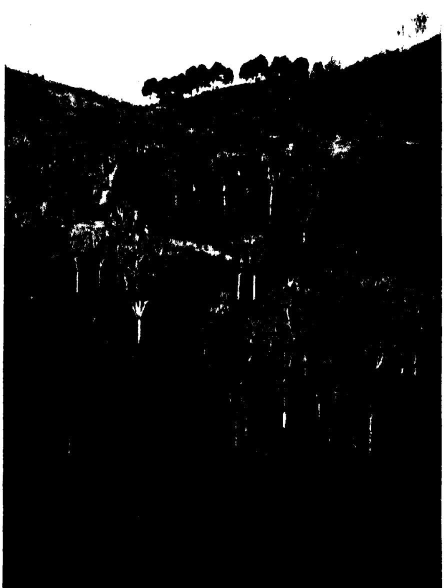

FIG. 8

FIG. 10

FIG. 7—Bamboo *Brachystegia* Woodland, west foot of Mwera Plateau (39° E., 10° 15′ S.).
FIG. 8—Encroaching Euphorbia Thicket, outer slopes of high block of Usambara, above Mombo (38° 15′ E., 4° 50′ S.).
FIG. 9—Thornbush at foot of high block of Pare, Same [name of the locality] (37° 50′ E., 4° 5′ S.).
FIG. 10—Saline Wooded Grassland, Pangani Trough, Lasiti; the trees are *Acacia sp.* (37° 40′ E., 4° 30′ S.).

3. *Bushland and Thicket* is land carrying a more than 50 per cent cover of densely growing shrubs or small trees; the trees and bushes may be evergreen or deciduous, spiny or nonspiny. The bushes have no clearly defined boles and may be from one to ten meters high. Tall trees may be present, either in clumps or widely scattered, but do not of themselves form a continuous canopy over the main bush cover; climbers are common. In the evergreen subtypes epiphytes are present. Herbs, both ephemeral and succulent, and dwarf grasses may form part of the ground cover in deciduous bushland. Thickets are close assemblages of coppicing virgate bushes. The baobab (*Adansonia digitata*) is a conspicuous dominant in parts of the deciduous thornbush.[4]

Three thickets of regional extent are shown on the map. The so-called "Itigi Thicket," astride the railroad near the eastern edge of the Central Plateau, covers 5000 to 6000 square kilometers. It is a dense, fully closed thicket of coppicing shrubs, 2.5 to 5 meters high, obviously to be explained by edaphic differences. This thicket, which was first mentioned by Burton,[5] forms an important natural barrier against tsetse fly. The "Msua Thicket," also astride the Central Railway, in its coastal sector west of the Ruvu Valley, covers some 800 square kilometers. It is a strange type of "semi-thicket low forest" composed of numerous tree species and abundant succulent or spiny shrubs and creepers, in places lichen-covered. It is probably maintained by mists that penetrate from the sea through the wide depression of the Ruvu Valley. The succulent Euphorbia Thicket, widely distributed on the slopes of the northern high blocks (Usambara and Pare), seems to be a well-established secondary growth where forest has been destroyed on slopes too steep or too stony for the development of grassland.

4. *Wooded Grassland* is land covered with grasses and other herbs, generally perennial, with trees and bushes, either evergreen or deciduous, grouped or scattered, occupying less than 50 per cent of the ground. The grasses dominate the aspect, but the woody species are always conspicuous. Perhaps more than the others, this type has suffered in interpretation from the "personal factor" and the seasonal changes of aspect. On the other hand, it has proved a useful omnium-gatherum for accommodating some doubtful subtypes near the border line between the prevailingly woody and prevailingly grassy types by a not too rigid adherence to the "less than 50 per cent" of the definition. Thus, as presented on the map, this main type includes a

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[4] Synonyms for this formation are *Laubwerfende Dornbuschsteppe*, *Trockenes Buschgehölz* (Engler); "thorn-bushland" (Warming); *Strauchsteppe* (Volkens); "thorn forest" (Shantz).

[5] R. F. Burton: The Lake Regions of Central Africa, 2 vols., London, 1860; ref. Vol. 1, p. 282.

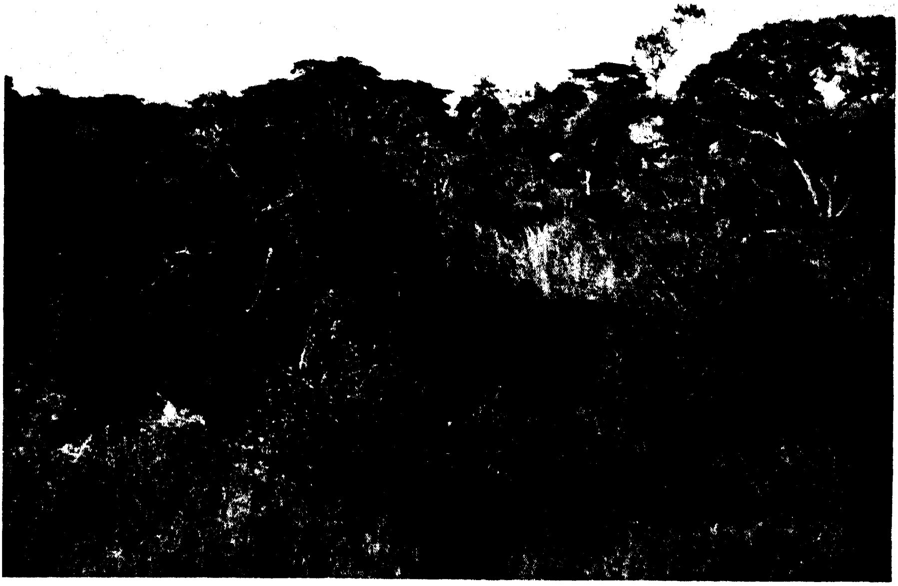

FIG. 11

FIG. 12

FIG. 11—Sharp boundary between Itigi Thicket and *Brachystegia* Woodland, following geological contact; at Km. 20, Singida Railway (34° 50′ E., 5° 35′ S.).

FIG. 12—Msua Thicket; at Km. 105, Central Railway (38° 35′ E., 6° 45′ S.).

FIG. 13

FIG. 14

FIG. 13—*Brachystegia microphylla* Upland Woodland, Bereku Ridge (35° 50′ E., 4° 30′ S.).

FIG. 14—Grassland with islands of remnant forest, Mufindi, Southern Highlands (35° 30′ E., 8° 25′ S.). (Photograph by P. J. Greenway.)

FIG. 15

FIG. 16

FIG. 15—*Acacia spirocarpa* Woodland fringing Pangani River (37° 30′ E., 4° 10′ S.).

FIG. 16—*Berlinia globiflora* Open Woodland, Sao Hill, Southern Highlands (35° 10′ E., 8° 20′ S.). (Photograph by P. J. Greenway.)

great variety and mixture of subtypes.[6] An interesting variety is occasionally met with where the woody forms grow more or less exclusively on termite mounds; and "Palm-Stand Grasslands" (*Borassus* and *Hyphaene*) are known from many parts.

5. *Grassland* is land covered with grasses and other herbs, sometimes with evergreen or deciduous trees or shrubs, widely scattered or in small isolated groups, occupying not more than 10 per cent of the ground. Two subtypes have been adopted for the map, based on a hydro-topographical subdivision: Valley Grassland, due to seasonal flooding; and Ridge and Slope Grassland, not due to seasonal flooding. In the latter have been included the High Altitude Grassy Scrub Formation, of upper Kilimanjaro for example.[7]

6. *Permanent Swamp Vegetation* consists of grasses, reeds (mostly papyrus), and rushes, and sometimes ferns, their stems rising out of the free water accumulated on the surface either from perennial flooding or from an outcropping ground-water table. Forests growing on similarly swampy land are shown as swamp or ground-water forests.

7. *Desert and Semidesert.* Vegetation is nonexistent, as in permanent or temporary salt pans or on rock and ice (alpine desert of Kilimanjaro), or is so thinly scattered that the aspect of the land is dominated at all seasons by the color of the soil. The plants may be low bushes or stunted trees, mostly spiny or thorny; succulent climbers; bulbous or tuberous succulents; and thinly scattered, mostly ephemeral grasses. The comparatively small areas carrying saltbush (usually *Suaeda monoica* exclusively), though of a denser physiognomic type and therefore included under Bushland by the Classification Committee, have on this small-scale map been grouped with the semidesert to which they belong geographically.

8. *Actively Induced Vegetation.* This concept was introduced at the author's suggestion in order to do justice to the physiognomic aspect of the highly mixed and constantly changing vegetation pattern presented by cultivated crops and their rotational shifts, pastures, the interspersed remnants of the original vegetation, and the great variety of scattered small areas of secondary growth. The concept, if accompanied by an adequate textual description,

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[6] In its main characteristics the term is probably synonymous with Engler's *Busch- und Baumgrassteppe* and Shantz's "acacia–tall grass savana," but it also includes part at least of the latter's "high grass–low tree savana" on the humid side of its normal distribution and his "acacia-desert grass savana" on the arid side. Likewise it covers well what is commonly referred to as "park land," "open bush," and "orchard (*Obstgarten*) steppe."

[7] Synonyms for Valley Grassland are *offene Grassteppe* (Engler), "tall grass" (Shantz); for Ridge and Slope Grassland, *Hochweideland* (Engler), a very misleading term, "mountain grass" (Shantz); for High Altitude Grassy Scrub, *Hochgebirgssteppe* (Engler), "alpine meadow" (Shantz), "Moor-Grassland" (Classification Committee).

should prove a satisfactory and scientifically correct way to indicate on a small-scale map the complexities introduced into a country's vegetational aspect by the activities of man. The term thus denotes a physiognomic type of vegetation produced by the direct or indirect influence of man's present occupation of the land; it does not include vegetation types that are the re-

FIG. 17—Semiarid vegetation in the Mkomazi gap between the southern Pare and the west Usumbara mountains. (Photograph by P. J. Greenway.)

sult of former human occupation, which are allotted to the physiognomic type they resemble in the present stage of natural or artificial rehabilitation. On a 1 : 2,000,000 map only the larger areas of induced vegetation can be shown—areas where human occupation is sufficiently dense, extensive, and concentrated to alter the appearance of the vegetation as a whole. The typical forms due to the bush fallowing of a more or less scattered population do not, as a rule, materially alter the aspect of the landscape, except, perhaps, when seen from high in the air; they are of an ephemeral nature and are, in any case, far too small for representation.

Because the introduction of this type has led to a good deal of controversy, and because actively induced vegetation is of considerable interest to the geographer, the following physiognomic descriptions of three of the six established subtypes will help to elucidate the application of the term.

FIG. 18—Baobabs in Thornbush, south foot of Kilimanjaro (37° 15′ E., 3° 25′ S.).
FIG. 19—Masai Bush, Nabarere Ridge (36° 55′ E., 4° 15′ S.)
FIG. 20—Open Wooded Grassland, Ardai Flats, west of Mt. Meru (36° 30′ E., 3° 20′ S.).

Fig. 21—"Orchard Steppe," Ugala Plains, south of Tabora (32° 10′ E., 6° S.).

Fig. 22—Palm stand (branched *Hyphaene coriacea*), foot plains of Kilimanjaro (37° 15′ E., 3° 25′ S.).

Fig. 23—Palm stand (unbranched *Hyphaene*), Bubu River delta near Bahi on the Central Railway (35° 20′ E., 6° S.).

Inland Plateau Massed Rural Settlements. These are the well-known "cultivation steppes," a term now considered misleading. The prevailing topography is flat or gently rolling ground interrupted by inselbergs. As much of the fallow land—from 20 to 90 per cent—is used for pasture, the general aspect is that of secondary grassland through which the villages or kraals are scattered. Here and there this grassland is interrupted by bush, regenerating or still uncleared, and by the strips of natural grassland occupying the seasonally inundated shallow valleys or depressions. Between the bare rock outcrops of the remnant hills are denser bush and thickets, or even woodland remnants, frequently deteriorated by browsing goats. Soil erosion is usually far advanced, and resulting barren sand flats are an integral part of the landscape. Where this type of induced vegetation has been formed from deciduous bushland with the baobab as a dominant, these giants remain as conspicuous relics.[8] The only permanent cultivations are the evergreen hedges of *Euphorbia tirucalli* around villages and cattle kraals, clusters of evergreen mangoes along the former Arab trade routes and the German administrative network, or small banana groves around an occasional seepage spring at the foot of a remnant hill. There are, of course, intermediate stages in the development of this type of induced vegetation, during which it takes on a patchier appearance—either on lands freshly occupied or after partial exhaustion of fertility and withdrawal of population.

Highland Massed Rural Settlements. These correspond to the *Hochweiden* of the German authors, a completely misleading term. The general aspect varies considerably with topography, native methods of tilling and grazing, and length of occupation. Smaller or larger remnant islands of forest, belts of secondary bracken and shrub, secondary bushland, often including euphorbia stands, and grassland form the ingredients of the frequently shifting pattern of the cultivated land. Banana groves and, in places, vegetable gardens are conspicuous; elsewhere, as on Kilimanjaro and in Bukoba, permanent coffee crops make the pattern more durable. Or again, grassland, whether primary or the result of former occupation by man, makes the background for the present-day, mostly scattered agriculture. Small groves of native reforestation, chiefly wattle, and the red or white scars of overeroded slopes complete the picture.

Coastal Foreland Settlements. These are usually comparatively narrow strips

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[8] See, for example, the description by P. J. Greenway in "The Vegetation of Mpwapwa, Tanganyika Territory," *Journ. of Ecology,* Vol. 21, 1933, pp. 28–43.

Mr. Greenway, botanist at the East African Agricultural Research Institute, Amani, is a member of the East African Vegetation Classification Committee; he kindly read the manuscript of the article.—EDIT. NOTE.

FIG. 24—Valley Grassland, Mkomazi Plain, foot of northern Usambara (38° 10′ E., 4° 40′ S.).
FIG. 25—Ridge and Slope Grassland, Masailand (36° 30′ E., 4° S.).
FIG. 26—Ridge and Slope Grassland, Ubena near Njombe (34° 50′ E., 9° 15′ S.).

on the flat, geologically very young coastal plains, but occasionally they extend into the lower reaches of the few great river valleys, or into the more attractive parts of the low-lying intermediate coastal hinterland, as at Dar es Salaam. This settlement type is characterized by extensive coconut-palm plantations and by such other evidences of long-continued outside influence (Asian and Portuguese) as mango and other fruit trees. The subsidiary, shifting cultivation of grains, pulses, and tubers is disappearing in the physiognomy of the dominating permanent arboreal cultures.

In addition to these and other types of vegetation induced by indigenous peoples, the map also shows vegetation induced by aliens on their farms, plantations, experimental stations, and mines. Many of the areas are exaggerated to make them visible.

The boundaries of the distribution of the baobab are also shown (inset, Pl. I). It is of much scientific interest and is not everywhere readily explainable. This first fairly accurate presentation, the result of many years of research and observation, may help to clear up points that are still doubtful.

Complexes and Catenas

Different vegetation types, often widely different, occur nearly everywhere in close conjunction or juxtaposition, a fact that raises a problem for small-scale map reproduction. The solution is to give such "complexes" or "intrazonals" separate, if only symbolic, notation to preserve the minor yet significant intermixtures in the general picture. Moreover, this "complex" notation permits fairly detailed generalized representation of such facts as rapid alteration of geological or edaphic conditions under a uniform climate, or historical developments in the immediate past under the influence of man and fire. The method used is as follows: The ground color is that of the dominating type, and the significant intrazonals are shown by circles or dots in the color of their type; the relative frequency of the "minors," where known, is indicated by the closer or wider spacing of the dots.

Extensive use was made of these complexes on the large-scale original draft, but technical difficulties in reduction have prevented their full reproduction on the 1 : 2,000,000 scale. The present map thus shows only two such complexes, the forest-grassland interrelations already described (p. 12), and an Induced Vegetation complex (red dots) on the Ridge and Slope Grassland (yellow background) in the areas where human occupation, or reoccupation, of the latter is scattered, as on the highlands around the north end of Lake Nyasa. However, the student of the map may find it useful to know the prevailing intrazonals in the other main vegetation types:

In Woodland: Fringing forest, inselberg vegetation, bushland, wooded grassland, thickets of "hardpan" types, grassland, induced vegetation.
Bushland: Fringing forest, woodland (near margins), wooded grassland, grassland, induced vegetation.
Wooded Grassland: Fringing forest, bushland, grassland, palm stands, induced vegetation.
Grassland: Fringing forest, thickets, wooded grassland, seasonal swamps, induced vegetation.
Permanent Swamp Vegetation: Swamp forest, thickets on termite mounds.
Semidesert: Saltbush scrub, grassland, palm stands.

Although these complexes are as a rule not predictable from a general contemplation of ground conditions, there is another type of complex that can be predicted if the relief is known. This is the "catenary complex" or "catena." The concept corresponds closely to that of the catena of soil science and is similarly caused by changes in the controlling factors according to their relative position on the relief.[9] The following may serve as a succinct definition: A catena is a distributional sequence of vegetation types determined by a given set of regularly repeated physiographic and/or hydrographic conditions (with their effect on soils), the arrangement of vegetation types being a function of local differences in topography that are constantly repeated over the catenary area. It will be seen that a "catena" is therefore not a category of classification as main types or subtypes are, for between one zone of the catenary complex and the next there is usually some principal classification line; it is merely a device to permit a more correct representation of the vegetational facts on a small-scale map than the usual misrepresentation that results from showing only a single dominant type.

Most of the catenas established during this study are of sufficiently wide extent to offer no difficulties in representation (in the form of "pajama stripes") even on a 1 : 2,000,000 map. In fact, one of them, the Central Plateau Catena, covers about 100,000 square kilometers, one-ninth of the country's surface. As the geographer will no doubt be interested in these "transzonal," topography-determined vegetational complexities, a detailed description of the three catenas included on the map seems warranted.

The Central Plateau Catena

On the moderately undulating peneplain, where broad, flat, gently sloping ridges alternate with shallow, low-graded, flat-bottomed, and seasonally inundated mature valleys, with inselbergs rising here and there, the

[9] G. Milne and others: A Provisional Soil Map of East Africa (Kenya, Uganda, Tanganyika, and Zanzibar) with Explanatory Memoir, *Amani Memoirs*, East African Agricultural Research Station, Amani, Tanganyika Territory, 1936 (see *Geogr. Rev.*, Vol. 26, 1936, pp. 522–523).—Edit. Note.

FIG. 27

FIG. 28

FIG. 27—Grass and Bracken Land, Matengo Highlands (34° 55′ E., 11° S.).

FIG. 28—Worn out Highland Massed Settlement, Mbwei Basin, northern Usambara (38° 25′ E., 4° 40′ S.).

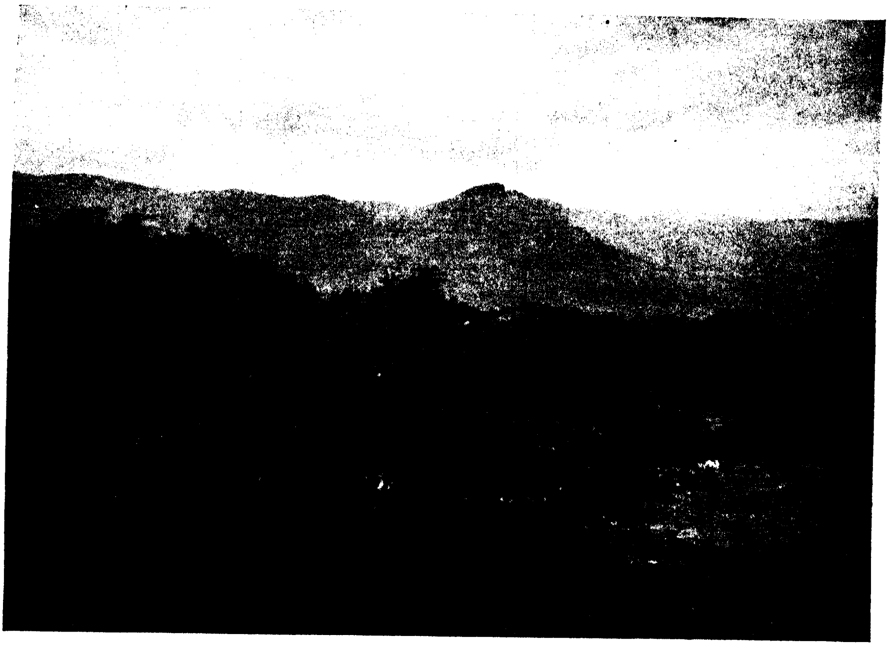

Fig. 29

Fig. 30

Fig. 29—Salt Bush, northwest foot of Usambara (38° 10′ E., 4° 30′ S.).
Fig. 30—Rain-Pond Catena, Masailand (37° 10′ E., 4° 30′ S.).

typical topography carries the following, likewise typical, vegetation sequence: on the comparatively well drained ridges and their upper and middle slopes, *Brachystegia*–Other Species Woodland (*miombo*); in the valley bottoms, Grassland; and marginal between them on the lower slopes, in varying width, *Combretum*–Other Species Bushland or Wooded Grassland. Characteristic, localized ingredients in this monotonous pattern are termite-mound and other thickets (in all three vegetation belts); patches of more open bushland or woodland on "hardpan" soils; patches of short grass on outcropping limonitic crusts; scattered baobabs along the valley edges (east of the Congo-Wembere divide); on the remnant hills a mixture of more luxuriant woodland thickets, tufted grass, and bare rock; and, finally, the small, shifting areas of native cultivation, both those under occupation and those that have reverted to secondary growth, and the regenerating thinnings left by the railroad fuel contractors. Where shallow ground water is present, it is often indicated by stands of *Borassus* palms. The relative width of the three belts composing this catena varies of course with the density of the drainage pattern of the wide, shallow black-clay depressions (*mbugas*), but the woodland belt is always the broadest and the marginal bushland the narrowest. The uniform catena pattern is interrupted by the few major drainage arteries; though intermittent, they retain sufficient ground or surface water in the dry season to support a permanent vegetation of bush fringes (frequently evergreen) or even fringing forest, and, where the scale permits, they should be distinguished on the map.

Ugogo and Masailand Catenas

On all the high blocks and some of the low blocks that lie in the rainshadow area of the eastern highland arc, within a range of 50 kilometers in the south and as much as 250 kilometers in the north, one observes a characteristic and often minute dovetailing of two vegetation types. The distribution here of *Brachystegia* Woodland and deciduous thornbush is clearly determined by the topographical exposure to moisture as expressed by both aspect and altitude. It is this changing exposure that provides the constantly repeated topographical element to which the catena concept is applied. It should be noted, however, that the Ugogo Catena is not merely a variety of the marginal and merging type Woodland/Bushland Intermediary but a proper catenary juxtaposition of pure woodland and pure bushland.

On the semiarid Masailand peneplain runoff in many parts is insufficient to carve distinct stream beds and merely collects in the numerous localized, shallow depressions of the mature surface, from which it quickly evaporates in the dry season. The alternation of these "rain ponds," or "pans," with

panless ground constitutes the repeating topographical and hydrographical basis for the Masailand Rain-Pond Catena—a sea of dominating thornbush with irregularly distributed islands of grassland usually surrounded by a narrow fringe of wooded grassland.

TECTONIC CONTROLS

The checkered pattern of the vegetation of the Territory is due primarily to the geologically recent shattering of the earth's crust in East Africa. The result of that shattering is a jumble of differentially displaced blocks. High blocks, troughs, and peneplain remnants, either still untouched by the present erosion cycle or already being carved up, at differing altitudes and often in close juxtaposition, form the main elements of the tectonic picture. In the north a large focus of recent volcanism and at the head of Lake Nyasa a smaller one add to the variety. This tectonic arrangement and its influence on vegetation can be roughly outlined thus (the reader is advised to follow the description on the physiographic and geologic maps[10]):

From the volcanic giants of Kilimanjaro and Meru in the north an almost continuous arc of high blocks trends south-southeastward toward the coast for 250 kilometers; in the immediate hinterland of Tanga it turns sharply to the southwest to run, bulging slightly southeastward, more than 700 kilometers to the north end of Lake Nyasa, where it ends in the southern volcanic focus. At about 150 kilometers from the lake an offshoot roughly following the 35th meridian comprises the high blocks of Ubena-Ukinga (Livingstone Mountains) and Songea-Matengo near the Portuguese border. On its whole extent of more than 1000 kilometers the arc drops in well-pronounced scarps to a much lower coastal hinterland of varying width—40 kilometers at Tanga, 440 kilometers in the latitude of Lindi. This practically uninterrupted step acts as an ideal condenser for the moisture brought in from the Indian Ocean, chiefly by the northeast trade wind on its short

[10] E. Harvey: Physiographical Map of Tanganyika Territory, [1 : 2,000,000,] Survey Division, Tanganyika Territory Dept. of Lands and Mines, Dar es Salaam, 1942; *idem:* Physiographical Map of Tanganyika Territory, 1 : 4,000,000, Geological Survey, Tanganyika Territory, 1932, accompanying E. O. Teale and E. Harvey: A Physiographical Map of Tanganyika Territory, *Geogr. Rev.*, Vol. 23, 1933, pp. 402–413; "Geological Map [of] Tanganyika Territory," 1 : 4,000,000, Survey Division, Tanganyika Territory Dept. of Lands and Mines, revised and reprinted 1946, accompanying Sir E. O. Teale and F. Oates: The Mineral Resources of Tanganyika Territory, *Tanganyika Territory Dept. of Lands and Mines, Geol. Division Bull. No. 16*, 3rd edit. rev., 1946. The "Report by His Majesty's Government . . . to the Trusteeship Council of the United Nations on the Administration of Tanganyika" for 1947 (*Colonial No. 220*, 1948) includes a contoured 1 : 2,000,000 map with administrative boundaries revised to date, also dot distribution maps of native population and educational facilities, 1 : 4,000,000. And see the Atlas of Tanganyika Territory described by Mr. Greenway elsewhere in this number of the *Geographical Review*.—EDIT. NOTE.

northern sector and by the southeast trade wind on its much longer southern one. In the southwest corner local condensation of the moisture produced by evaporation from Lake Nyasa seems to replace to a large extent the high-block condensation of the moisture brought by the trade wind, which, at this distance from the coast, must be greatly reduced. Normal annual precipitation above 1250 millimeters—frequently 2000 millimeters or more—is the rule, and consequently the natural vegetation of the upper reaches of this highland arc is evergreen forest. The arc itself is the hydrographic axis feeding all the Territory's main drainage basins to the south and east of the Great Rift Valley shatter belt, which itself has no outlet to the sea.

At the scarp foot, between the arc and the isolated outliers of Mahenge and Uluguru, are the tectonically determined depressions of the Kilombero and the Wami. The vegetation pattern of the prevailingly alluvial land is composed of wide grasslands of the valley subtype that harbor occasional large permanent swamps and countless minor ones and are fringed by wooded grasslands that merge outwardly into the woodlands of the surrounding higher ground. A similar trough borders the southwestern foot of the northern sector of the highland arc in the shape of the great Pangani depression, mostly rain-shadow land with prevailingly eluvial soils, swampy in the immediate vicinity of the river but elsewhere carrying typical semiarid vegetation types, including small areas of semidesert.

Adjoining the high-block axis of condensation on the west and northwest lie the much lower tectonic tilt blocks that in Tanganyika Territory take the place of the true Great Rift Valley of Kenya. This vast wedge-shaped rain-shadow region, narrow in the south and widening northward through Ugogo into Masailand, has a mean annual rainfall of only 500 to 750 millimeters. The prevailing vegetation is semiarid bush and wooded grassland with occasional patches of pure grassland of the ridge and slope subtype. On the west the agglomeration of relatively low blocks is again bounded by higher ground. In the north the well-marked scarps of the "Great Rift Wall" rise locally to such heights that, with the superimposed still higher "giant caldrons" of the Ngorongoro district, they create a secondary belt of relatively high precipitation and evergreen forest, mostly "mist forest." In the south more easily graded escarpments lead to the surface generally referred to as the "Central Plateau," where the gently undulating topography of a vast peneplain remnant dominates the landscape. The rainfall is between 800 and 1200 millimeters, and the peneplain is the typical home of *Brachystegia*-Other Species Woodland, which, along with the peneplain, stretches far west across the Tanganyika and Nyasa troughs into Katanga, Northern Rhodesia, and Angola.

In the northwest corner of the Territory is the shallow tectonic basin of Victoria Nyanza. The evaporation from this vast sheet of water, driven by heavy rainfall, ranging from 1500 to 3000 millimeters. Little is left today of the former "evergreen forests" that resulted from these conditions. A dense population with an economy based largely on coffee, maintains extensive areas of actively induced vegetation. What remains of the forests is almost exclusively of the swamp or ground-water subtype. Farther away from the lake shores rainfall decreases to the west and south and woodland, bush, and wooded grassland become the dominating vegetation types.

Between about 3° and 6°30′ S. the peneplain of the Central Plateau dips gently westward, until, roughly along the 31st meridian, it abuts against the step of the arc of high blocks marking the eastern edge of the Lake Tanganyika rift valley in Kobondo, Uha, and northern Ubende. The postpeneplanation cycle of erosion determined by the new Lake Tanganyika base level has cut, and is cutting, deeply incised valleys in the mostly unmetamorphosed clastics of these plateaus, tending to reduce them to isolated blocks. Topographically and hydrographically the terrain differs greatly from the gently undulating peneplain surface on the old basement schists and granites of the Central Plateau, as yet untouched by the new cycle. Along the line of contact between these two morphological types lies a fairly broad belt of recent or present-day alluvial fill. This triple change of topography results in the corresponding change of vegetation types shown on the map: in the east the Central Plateau Catena; in the middle large permanent swamps, seasonally inundated grasslands, and wooded grasslands covering in the aggregate some 9000 square kilometers; and in the west the "closed *Brachystegia* Woodland," only irregularly interrupted by the more open vegetation or the fringing bush or forest of the valley bottoms. Only in the highest parts of this region does one still find remnants of evergreen forest, the home of the chimpanzee, now mostly become secondary, fire-created grassland or scrub.

From 6° 30′ S. to 9° S. the tectonic pattern is dominated by the Lake Rukwa rift trough. Vegetationally this is a typical rain-shadow area, its aridity somewhat mitigated by the rather ample runoff from the bordering high blocks: southern Ubende in the north, Ukimbu in the east, Ufipa in the west, and Umalila in the south. The runoff sustains some fair-sized perennial swamps, but because of the exceptionally powerful evaporation in what is probably the hottest part of the Territory it fails to keep the basin of Lake Rukwa permanently filled. The northern two-thirds of the "lake" are periodically dry and then carry only a sparse semidesert vegetation.

In the great rectangle of southeastern Tanganyika, between the Ruvuma River and 9° S. from the foot of the great inland scarps to the sea, tectonic

disturbances, though locally recognizable, are regionally far less pronounced, with the result that the vegetation pattern is monotonously uniform: *Brachystegia* Woodland, with its marginal intermediaries toward bushland, reigns supreme over the broad sedimentary ridges and across the minor valleys of these plateaus built largely of Mesozoic and Tertiary clastic rocks. The rainfall ranges from 800 to 1100 millimeters. Only the larger drainage channels and the numerous deeply scooped-out headwater erosion bays show the usual more open vegetation types or, in favorable positions, fringes of denser bush or even Forest/Woodland Intermediary types. On some of the plateau blocks near the coast with a rainfall probably somewhat higher these intermediaries occasionally cover larger areas.

The Brachystegia–Other Species Woodland

Whereas the tectonic control of the vegetation pattern has to be carefully read into the map with the aid of topographical and geological maps, the vast extent of the *Brachystegia*–Other Species Woodland, locally referred to simply as *miombo*, almost immediately catches the eye. In two major units, one in the northwest with a substantial outlier in the Central Province and one in the southeast, measuring respectively about 220,000 and 240,000 square kilometers exclusive of the enclosed miombo-free areas, this vegetation type covers a total of 460,000 square kilometers, or nearly one-half of the Territory's land surface! These two great lobes are separated by a miombo-free corridor, 500 kilometers long and widening from 60 kilometers in the southwest to 120 kilometers in southern Masailand. Thence the miombo-free regions stretch across the whole of northern Tanganyika from the coast to the east shore of Lake Victoria and across the Kenya border. Comparison with the geological and soil maps finds that miombo woodland is present on nearly every mapped geological formation or soil type, the only exceptions being certain limestones, both old and new, that produce heavy clay eluvia, certain Karroo shales that likewise weather into heavy clays, and the heavy clayey alluvia of the inundation plains, all three forming heavy and badly drained soils; the too well or too rapidly drained soils of certain Pliocene duricrusts (coincident with the Itigi Thicket);[11] and the terra rossas of the karstic Pleistocene coral limestones of the coast.

To talk of "miombo soils" is grossly misleading. The most plausible explanation of the absence of miombo from the northern regions of the

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[11] See Mr. Gillman's discussion in G. Milne: A Soil Reconnaissance Journey through Parts of Tanganyika Territory December 1935 to February 1936 [edited by C. Gillman]. *Journ. of Ecology*, Vol. 35, 1947, pp. 192–265; reference on p. 225.—Edit. Note.

Territory fits in well with the idea that miombo woodland is a function primarily of climate—more precisely, of rainfall distribution. This peculiar vegetation type apparently requires a rainfall of 800 to 1200 millimeters without the well-marked pause in midsummer that characterizes the regions under the influence of the northeast trade wind. Miombo-free islands within this miombo climate are due to locally unfavorable edaphic conditions produced by hydrological rather than chemical differences of the soils.

As the home of the common tsetse fly (*Glossina morsitans*) the *Brachystegia*-Other Species Woodland is, perhaps excusably, regarded with disfavor by the administrator and the economic "planner." It would seem a profitable task for the geographer to assist not only toward a better understanding of its extent and present economic limitations but also toward a scientifically correct improvement of these lands that must inevitably be looked upon as the chief reserves of the future.

Forest Remnants

Of equal, or perhaps even greater, urgency is the threat to the country's water resources through the destruction of the evergreen forests on the main watersheds. The vegetation map brings out instructively the pitifully small remnants of forest by the use of solid black for an "eye opener"—and many of the black patches had to be exaggerated to make them visible at this small scale.

The geographer should never tire of pointing out, with all the scientific emphasis at his command, the important interrelations between the small still-forested uplands and the vast foot plains. The plains can remain, or again become, the home of a stable peasantry only if the forests are protected against the rapacious inroads of the mountain dwellers and if their rehabilitation is energetically furthered without delay in the many areas where deterioration is advanced.

Alien Plantations and Native Land Occupation

Another salient point on the map, rectifying a commonly held exaggeration, is the insignificance of the alien plantations and farming settlements, not only when compared with the total surface, on which these tiny specks of land—colored bright red for emphasis—literally almost disappear but even when contrasted with the extent of native land use. However unpalatable this fact may be to the politician and the land speculator, the geographer studying the vegetation map cannot fail to draw the inevitable conclusions and follow them up with his warning voice!

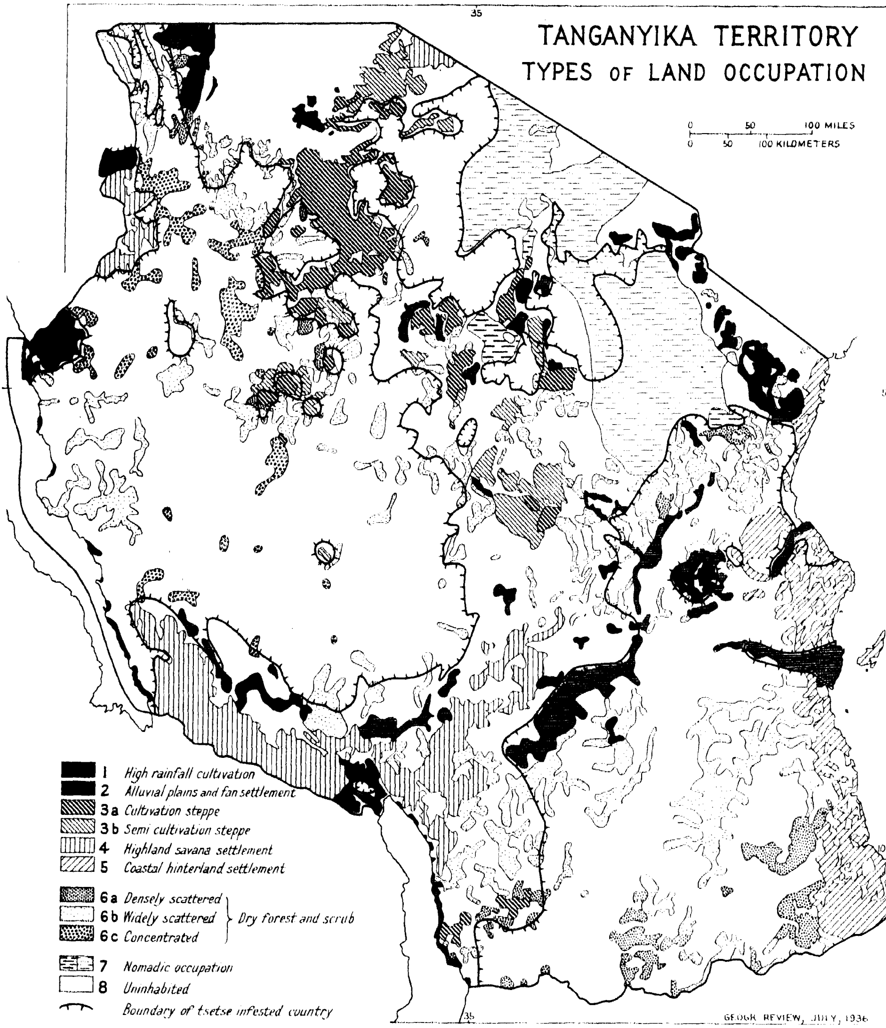

FIG. 31—This map is reproduced from the article "A Population Map of Tanganyika Territory" (*Geogr. Rev.*, Vol. 26, 1936, p. 356) in order to correct a misapprehension affecting the map and also the table on p. 357. The large areas in the western part of the Southern Province shown as "uninhabited" or occupied by a "widely scattered population" were attributed to the absence or only sporadic occurrence of permanent domestic water. At the time of writing the author, having no personal knowledge of these regions, was forced to rely on the scant available older literature. He later had the opportunity for extensive exploration of the Ruvuma basin, which revealed comparatively ample permanent streams and compelled him to account for the sparsity of population on historical grounds (see reference in footnote 12).

This new vegetation map presents nothing factually new regarding the distribution of the native agricultural and pastoral activities of Tanganyika Territory. For it merely repeats, this time in bright colors, the visually less impressive picture of the author's population map. However, to the serious

student it may become a useful tool for checking, with the aid of the vegetation pattern, the conclusions arrived at earlier regarding the interdependence between the Territory's population and the hydrographic patterns.[12]

APPENDIX I—COMPARISON WITH EARLIER MAPS

It may be useful to compare this map on the comparatively large scale of 1 : 2,000,000 with such earlier attempts on smaller scales as those of Engler (1910)[13] and Shantz (1923).[14] On Engler's map there are four main errors. (1) The extent of the *Hochweiden* is far too wide. In any case, the term is misleading, as some of the earlier writers had recognized (see, for example, *Tropenpflanzer Beihefte*, Vol. 6, 1905, p. 325); it is now replaced by Ridge and Slope Grassland. (2) The *offene Grassteppe* obviously includes many of the "cultivation steppes" (another term no longer tenable) now classed with Actively Induced Vegetation. The distribution of these "steppes" in the days of Engler's authorities differs considerably from that of today, so that comparison of the old and new maps provides welcome information regarding the shifting of human activities. Note particularly the large extent of open ground stretching for 200 kilometers northwest of Tabora, which has today mostly reverted to woodland and is replaced on the present map by an open, elongated oasis, centered on Tabora. The large triangular patch of *Grassteppe* bounded by the 36th meridian and the parallel of 6° S. is definitely wrong, for most if not all of this ground forms, and presumably always has formed, part of the great Masai Thornbush. (3) The long strip of *Salzsteppe* in the Wembere depression is now more correctly included in seasonally flooded Valley Grassland. (4) The extent of Forest, of both types, on the Uluguru Mountains above Morogoro is far too large even for those early days; today it is only a narrow crescent-shaped remnant between two large areas of Actively Induced Vegetation.

Shantz repeats Engler's errors 1 and 3. It is therefore all the more difficult to understand why he has, quite erroneously, replaced Engler's correctly shown vast area, some 240 square kilometers, of *Brachystegia* Woodland (*Trockenwald*) between 9° S. and the Portuguese border with "acacia-tall grass savana." Another serious error is found in central and eastern Masailand, between the Pangani River and 37° E., where Shantz calls "acacia-desert grass savana" what in reality is mostly dense, thorny, deciduous bush.

For the admittedly highly variegated vegetation pattern of the coastal hinterland between 6° and 11° S. Engler coined the obviously *faute de mieux* term *Parkartiges Gehölz des Küstenlandes;* Shantz shows "thorn forest"; Koegel, the compiler of the vegetation map in the 1933 edition of Meyers Grosser Hand-Atlas, gives "lower tropical rain forest," a term that unfortunately has gone into several modern school atlases. Swynnerton (*Trans. Royal*

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[12] See, for example, C. Gillman: A Reconnaissance Survey of the Hydrology of Tanganyika Territory in Its Geographical Settings, *Tanganyika Territory Water Consultant's Rept. No. 6,* 1940; the same: The Geography and Hydrography of the Tanganyika Territory Part of the Ruvuma Basin, [Dar es Salaam,] 1943. (The initial quotation of this article is taken from the latter report.)—EDIT. NOTE.

[13] A Engler: Vegetationskarte von Deutsch-Ostafrika, 1 : 6,000,000, in his "Die Pflanzenwelt Afrikas, insbesondere seiner tropischen Gebiete" (Die Vegetation der Erde, Vol. 9, Part 1), Vol. 1, Leipzig, 1910. The map is Plate II.

[14] H. L. Shantz: Vegetation Map of Africa, 1 : 10,000,000, accompanying H. L. Shantz and C. F. Marbut: The Vegetation and Soils of Africa, *Amer. Geogr. Soc. Research Ser. No. 13,* 1923. The map is Plate I.

Entomol. Soc. of London, Vol. 84, 1936) is probably nearest the truth in his "Coastal Debris," which he defines as "plantations abandoned and others with remnants and regenerating patches of woodland and thicket." An attempt made by the compiler of the present map to work out a catena to represent this gamut from rain forest, through woodland and thorn, to secondary man-created vegetation was eventually abandoned in favor of plotting our admittedly still somewhat vague and uneven knowledge in preference to representations too much burdened with the personal factor.

APPENDIX II—NOTE ON SOURCE MATERIALS

The basic source materials were the author's own field books and travel diaries covering his railway and hydrographic surveys from 1913 to 1946, during all of which ample and continuous notes were made on the vegetation of the country traversed. The following approximate summary figures will show the extent of these traverses, which covered, at varying density, most parts of the Territory:

I. On foot:	Railway alignments	2,500 km.
	Railway reconnaissance surveys	7,000
	Auxiliary surveys	600
		10,100
II. By car:	Railway reconnaissance surveys	3,350
	Auxiliary surveys	400
	Water Consultant's hydrographic surveys	9,450
		13,200
III. By air:		4,200
	Total	27,500 km.

Not included in this total are many repetitions of traverses which afforded opportunities for checking up and for gauging changes of the vegetation during three decades.

To supplement this "personal framework," the following published and unpublished material was consulted:

Published map series:
Deutsch-Ostafrika, 1 : 300,000, German original sheets, 1894–1916.
" " 1 : 1,000,000, " " " 1908–1911.
Usambara und Kuestengebiet, 1 : 100,000, German original sheets, 1911–1912.
Anglo-German Boundary Commissions of the northern and southern boundaries.
Ruanda-Urundi (parts of), 1 : 200,000, Belgian edition of 1937.
Coastal strip map, 1 : 50,000, South African Air Force, 1942–1944.

Other published maps:	60 items
Published books and papers	67
Unpublished departmental maps	126
" " reports and papers	89
Railway field books by surveyors working under the author's direction	15
Total	357 items

For the last three groups the author is much indebted to the Departments of Railways, Tsetse Research, Forests, and Agriculture, who very courteously facilitated his researches by putting their map collections and files at his disposal.

Time of Compilation

To compile the drafts for the 25 sheets of the 1 : 500,000 map took in the aggregate

1300 hours of working time, between December, 1944, and February, 1946; for the draft of the 1 : 2,000,000 reduction it took 170 hours between March and June, 1946.

Illustrations

In addition to the photographs published with this paper, it will be profitable for the student to consult Burtt's "Some East African Vegetation Communities" (see footnote 2, above), which contains further instructive views. In this the following main types of the present classification are illustrated: Forests, photographs 51, 52; Woodland, 1, 2, 3, 7, 8, 10, 11, 14, 22, 24; Bushland, 36, 37; Thickets, 19, 40, 43, 45, 46; Wooded Grassland, 17, 18, 21, 27, 28, 29, 47, 48, 49; Wooded Grassland with Grassland Complex, 32, 50; Ridge and Slope Grassland, 31; Actively Induced Vegetation, 38.

As regards Shantz's illustrations, the present classification would call Figures 20, 21, 27, and 28 Wooded Grassland and Figures 25 and 26 Ridge and Slope Grassland.

EDITORIAL NOTE. The drawing supplied by Mr. Gillman for the map base was used, and his color scheme was followed as closely as was compatible with the problem of reproduction of a complicated pattern employing a limited number of color plates. Special thanks are due to Mr. A. B. Hoen for his personal interest in, and supervision of, the map.

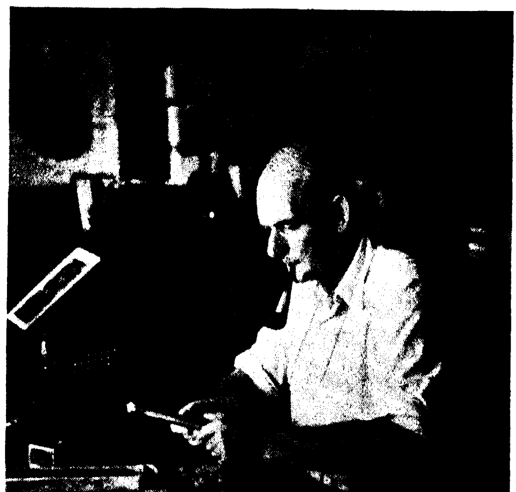

FIG. 32—Clement Gillman in his study, 1937. (From "Focus on Africa" by Richard and Mary Light, *Amer. Geogr. Soc. Special Publ. No. 25*, 1941.)

THE YELLOW RIVER REHARNESSED

O. J. TODD

AFTER nearly nine years at large, meandering over a broad belt of good farmland, the Yellow River has again been put under control. With the aid of staff, funds, and critical materials furnished by UNRRA, this latest task of harnessing the floods of China's most unruly stream took a little more than a year, beginning in early 1946. The main flow was turned back into its old course in mid-March, 1947; the work of cutting off seepage and completing waterproofing of the main diversion dam lasted several weeks longer. The project was given top priority because of the effect it would have on the world's food supply and the prompt aid it would give China in her postwar emergency. It was carried out under difficulties because of the chaotic conditions in which China found herself at the close of World War II.

EFFECT OF 1938 DIVERSION

China's millions had been hungry for eight years; for the Great Plain, with its more than 50 million people, must produce normal grain crops to prevent famine. This vast area has been built up by deposits spilled over the banks of the Yellow River. The deposits that reach the delta and the sea in average years total an estimated 22 billion cubic feet, or some 500,000 acre-feet—if all the flow is held within the diked course.[1]

China's increasing population has always settled on every acre of this land as rapidly as it could be reclaimed. Estimates made in northern Shantung in 1920 by American missionaries in Tehsien (Techow) showed a density of 1200 to 1500 people to a square mile in rural areas. They are not importers of food, with the exception of a few luxuries in small quantities. It is because of this crowding and the need for full crop production that a major change in the course of the Yellow River has an immediate effect on the food supply of large numbers. Such was the case in June, 1938, when the south main dike was cut at the village of Huayuankou (flower-garden mouth), about eight miles east of the Peiping-Hankow Railway bridge where the alluvial fan spreads out from the high loess bluffs of Honan. The cut was made to block the advance of the Japanese Army after its capture of Kaifeng. Already, how-

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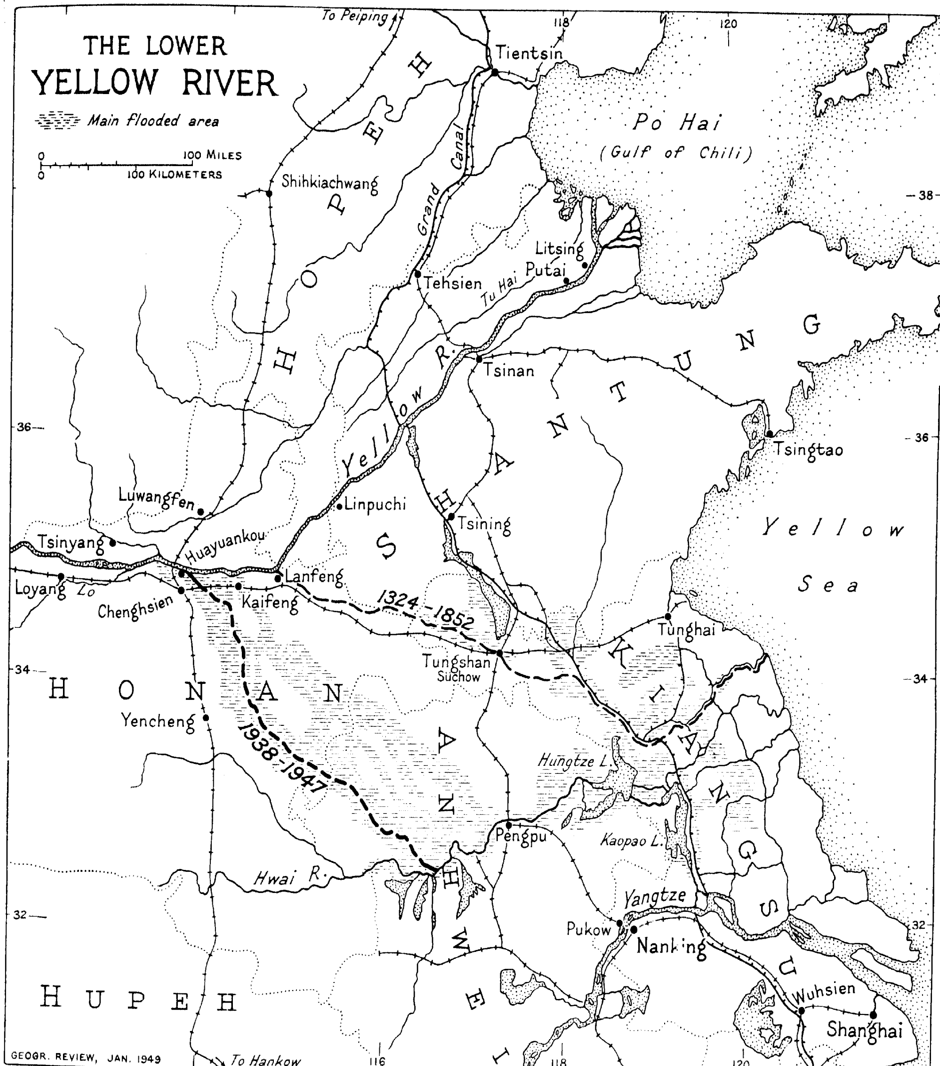
[1] O. J. Todd and S. Eliassen: The Yellow River Problem, *Trans. Amer. Soc. of Civil Engineers*, Vol. 105, 1940, pp. 346–453 (discussion, pp. 417–453); reference on p. 404. (Also published, without discussion, in *Journ. Assn. of Chinese and Amer. Engineers*, Vol. 20, 1939, pp. 1–17, 73–94, and 109–139.)

➤MR. TODD, a civil engineer of Palo Alto, Calif., has spent 21 years in active engineering practice in China, specializing chiefly in flood control and irrigation.



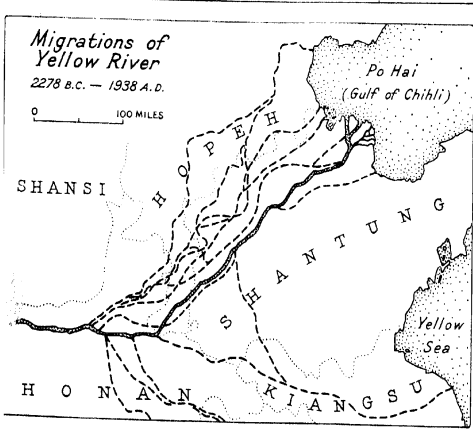


FIG. 1—Map of the lower course of the Yellow River showing the areas flooded by the 1938 diversion, from a map prepared mainly in the office of CNRRA and showing conditions in 1939. Probably nearly six million acres were under water in the early stages; then definite channels became scoured out that took the main flow, reducing the land out of use to about two million acres. Scale of map approximately 1 : 6,500,000.

FIG. 2—Principal migrations of the Yellow River from 2278 B.C. to the 1938 diversion. For a map of the dike system of the Yellow River see "China: Land of Famine" by Walter H. Mallory. *Amer. Geogr. Soc. Special Publ. No. 6*, 1926, pp. 50–51.

ever, thousands of farmers had fled to western Honan and Shensi, abandoning huge tracts of good farming lands that were soon to be inundated.

The topography of the country about the point of diversion is such that no natural divide prevents the Yellow River from flowing southeast to join the Hwai west of Pengpu, as happened in the 1938 diversion. A similar break in the south dikes of the Yellow River less than 10 miles east of the Huayuankou break of 1938 occurred in 1887, when neglect and insufficient stone protection caused the failure. Though the Chinese tackled the job of rediversion at once, it took two seasons to get the flow back into the old channel. But the long war lasting from 1937 to 1945 prevented any such prompt check on the river's most recent rampage.

In 1944, when China urgently asked the assistance of the United Nations, it was asserted that here was an opportunity to increase the world's food supply by an estimated two million tons annually through rehabilitation of nearly two million acres of good farmland that had been partly or entirely taken out of dependable production. There was also the need of relieving Shensi and western Honan of the burden of feeding the refugee farmers and returning them—six million of them—to their old lands. But first the Yellow River must be thrown back into its old course, the flooded area drained, and the tributaries of the Hwai River cleaned of the new mud and sand deposits carried into them from the Yellow River basin during the years that "China's Sorrow" had been trespassing over another river's territory.

In the past 42 centuries the Yellow River has followed 15 main channels for long distances, nine of them widely divergent.[2] The many mended breaks along the present channel are indicated by loop dikes all along the eastern Honan, Hopei, and western Shantung stretches of the main dike system. Breaks have also occurred in Shantung east of the Tientsin-Pukow Railway. That between Putai and Litsing in 1921 is the most notable; it was not entirely mended until the summer of 1923. Another major dike break, at Linpuchi in western Shantung in 1935, let the entire river flow through regions just west of the Grand Canal; this breach was healed in the spring of 1936. Remnants of major diking systems nearly as far north as Tehsien, Shantung, and extending south into the region of Suchow, Kiangsu, tell part of the river's history.

After the Chinese had held the river to one main course for five centuries (1324 to 1851–1852), with its mouth near Haichow on the Yellow Sea, it was not considered practical to throw it back into the heavily silted channel abandoned when a dike break occurred in 1851 near Lanfeng, Honan. There-

[2] J. R. Freeman: Flood Problems in China, *Trans. Amer. Soc. of Civil Engineers*, Vol. 85, 1922, pp. 1405–1460; reference on p. 1415.

after the course was to the northeast into the Po Hai (Gulf of Chihli). A substantial diking system maintained this new course with only temporary interruptions up to the time of the man-made breach of June, 1938, at Huayuankou. For the present at least, this seems to be the logical channel for the discharge of this principal artery of North China.

Nature and Habits of the River

In the early autumn of 1945 I was invited to represent UNRRA as chief "adviser" to the Yellow River Commission, working with that organization, the National Conservancy Commission of China, and CNRRA (China Relief and Rehabilitation Administration), as well as with UNRRA, which was appointing me and to which I would regularly report. The Yellow River was an old friend; the invitation to wrestle again with its dragons was enticing; I accepted, drew up tentative plans for diversion based on the sketchy information available, and ordered equipment and supplies to be shipped from Portland, Oreg., for delivery to Shanghai before February, 1946.

Long familiarity with this river had taught that silt loads might be, for a time, as high as 40 per cent of the flow by weight, though such concentrations were rarely found farther downstream than Tungkwan, at the great elbow in Shensi Province where the muddy Wei Ho comes in from the west bringing the silty flow from the King River. Both streams rise in the heart of the region with heaviest silt overburden. During the work of irrigation development for the Wei-Pei region of Shensi in 1931–1932 the China International Famine Relief Commission found that the King River had mud loads carrying 48 per cent by weight in solids. Investigations on the Fen Ho near Taiyüan, Shansi, showed 23 per cent of solids by weight at flood time. According to the Yellow River Commission a small tributary of the Yellow River in western Shansi near Liu Lin had a silt content of 33 per cent during the summer freshets in 1935. But in the low-water season in the winter and early spring one can swim in the Yellow River without getting muddy; the silt content then is less than 1 per cent.

The rainy season is in the summer, usually beginning in late June and ending in mid-September. It rarely lasts more than three months in the Yellow River basin. On the Great Plain average annual rainfall is little more than 20 inches in the north, but it increases toward the south. However, the main watershed of the Yellow River to the west of the Great Plain has an average annual rainfall of only about 12 inches, and in Mongolia it is considerably less. Data are few, and the figures adopted are combined from reports considered the most dependable.

Although in the early 1920's American engineers had placed maximum

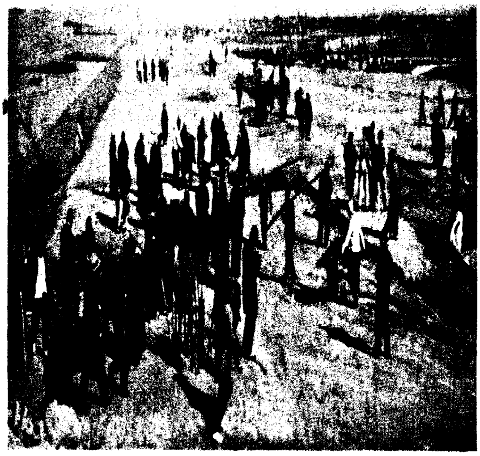


FIG. 3—Building large earth dike at west end of closure structure at Huayuankou, Honan, April, 1946.

FIG. 4—Building willow and kaoliang revetment facing for main closure dike at Huayuankou, May, 1946.

FIG. 5—Wheelbarrow coolies moving earth to build closure dike at Huayuankou, June, 1946.

FIG. 6—Looking west along earth section of closure structure from mound at west end of trestle, December, 1946.

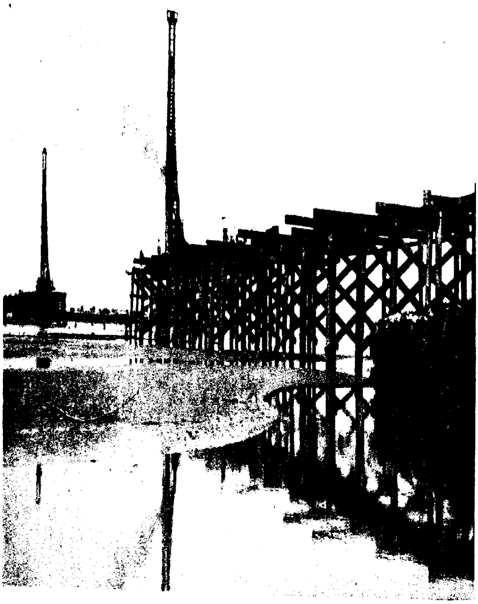


FIG. 7—Trestle nearing completion at Huayuankou, June, 1946.

FIG. 8—Closing the final gap in the 5000-foot-wide break at Huayuankou by use of long willow-stone "sausages."

FIG. 9—The diversion work nearly completed, early 1947.

FIG. 10—Willow trees used to stop bank cutting along the Yellow River in west Shantung.

flow in the Yellow River at 500,000 cubic feet a second, later studies showed the likelihood that a flood with a discharge of nearly a million cubic feet a second would reach the Great Plain once in a century. This is approximately one-third of the estimated maximum flow of the Mississippi or the lower Yangtze. But the heavy silt load adds enormously to the trouble of controlling the Yellow River. And in the matter of discharge it should be stated here that the minimum flow of the river at the Peiping-Hankow Railway bridge, the head of the great alluvial fan, is estimated at about 5000 cubic feet a second. This extreme fluctuation in flow suggests a comparison with the Colorado. Very little winter precipitation falls on the Yellow River watershed, so that the melting of snow is of minor importance in river stage; but when it does come, in late March or early April, the so-called "peach blossom" flood occurs in Honan and Shantung. This early-spring rise rarely brings a discharge above 75,000 cubic feet a second. Then the river drops back rapidly to low-water stage until the advent of the summer rains.

All river engineers in China know these habits, and the "river police" responsible for dike maintenance plan their work according to the season. They know when to expect mud and rain and when the dust storms are so bad that the workmen are forced to take cover behind the stacks of kaoliang stalks hauled in for dike revetment. They are also aware of the ice hazards, remembering that anchor ice appears in early December and thin cake ice in January. If the winter is extremely cold, the ice lodging at some narrow point may create a jam, which ponds the river and shears off the bank protection. Then is the time for the long willow ice-protection poles to be placed by the River Bureau crews. But not all the winters are severe. In 1945–1946 there was little ice in the river. The next winter we fought floating ice four inches thick or more, but no jam formed in front of the closure work or elsewhere on the river, partly because a crew was maintained to break up the large ice cakes as they approached the piers. Men with improvised hammers of 50-pound stones tied to heavy wire pounded the ice until the cakes were broken into small pieces; for two to three weeks this work was carried on night and day.

The Plan of Operations

I reached China in mid-December, 1945, and in early January, 1946, a small group of us gathered at Kaifeng, Honan, to make a field inspection. I had arranged through Mr. Benjamin Kizer, China director for UNRRA, and Dr. T. F. Tsiang, director for CNRRA, for an investigation of the dikes from the Huayuankou break to the Grand Canal by a three-man party of

engineers in which the National Conservancy Commission and the Yellow River Commission would each have a representative and I would represent UNRRA. In spite of the tense political situation and the attendant difficulties of transport we managed to see much of the south dike from the Peiping-Hankow Railway bridge east into Shantung and past Linpuchi, where the break of 1935 had occurred and where I had spent many weeks early in 1936.[3] This section had been reported as in need of large-scale repairs because of removal of rock revetment and other destruction during the war. Happily, however, we found the dikes for miles almost as I had last seen them in 1936; for they had been well built of good material with enough clay or lime-containing soil to bind the earth into a stable monolith. Gullying by rains was not extensive, and neither was the cutting by native carts crossing the dikes to the new fields inside the old river bed. To the engineer these marks of deterioration were small when compared with the total mass of the dike system. Rock revetment was intact in most places, except where the military forces near Chiho, west of Tsinan, had torn out bank lining to build forts for use in the civil war. The greatest loss was far to the east where the kaoliang-stalk bank protection had rotted or had been burned to make campfires for soldiers.

We agreed that the main project should be undertaken at once. The 400 miles of diked channel to the northeast could be repaired, and the river rediverted to its old course, within the year if full cooperation could be obtained. The plan was to build a rock-fill dam for the water-covered section of the break and an earth dike for the remaining 3400 feet of the total width of 5000 feet.

Material and Equipment

Central China has generous supplies of easily quarried limestone. Old quarries close to the break at Huayuankou were visited as soon as our party returned from western Shantung. The old quarries at Heishihkwan near the Lunghai Railway, 60 miles west of Chenghsien, proved suitable, but the bridge across the Lo Ho a few miles to the east had been washed out and sections of the railroad had been robbed of the good steel and 35-pound rail substituted. That put a damper on immediate use of the quarries for obtaining supplies of "one-man size" stone (pieces that one man can carry on his back) for the construction of the dam. From December, 1946, to May, 1947, however, we were able to ship 40,000 cubic yards of rock from the quarries at Heishihkuan after the railroad and its bridges had been put in order.

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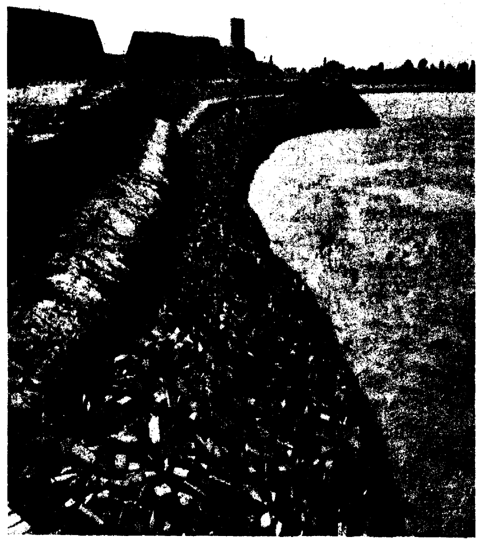
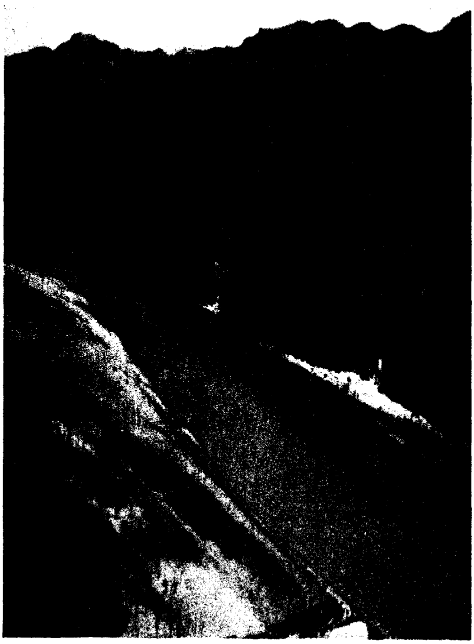
[3] O. J. Todd: The Yellow River Dike Breaks of 1935, *Journ. Assn. of Chinese and Amer. Engineers*, Vol. 17, 1936, pp. 126–138.





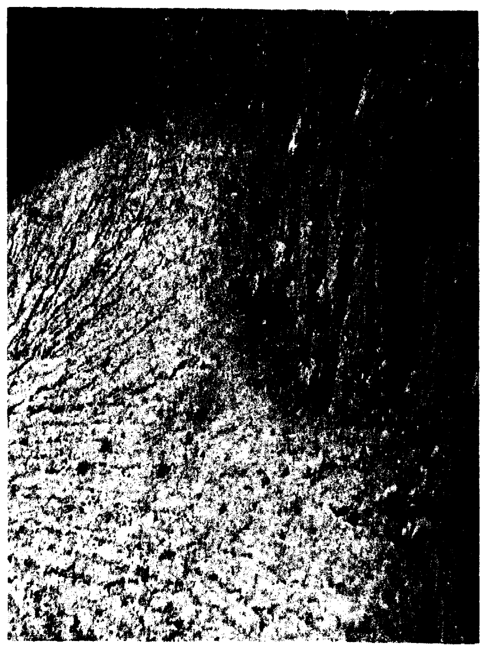
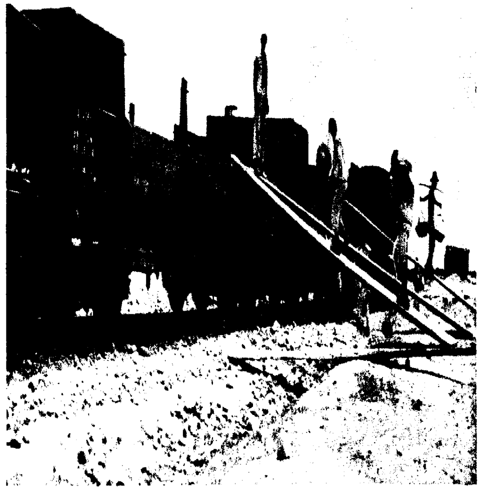


FIG. 11—The Yellow River thrown back into its old course at Huayuankou showing silting after the first summer flood wave had receded, July, 1947.

FIG. 12—The Yellow River cuts through loess-covered hills to a depth of 1500 feet in east-central Shensi at the Shansi border.

FIG. 13—Brick-protected dike, south bank of Yellow River, near Kaotsun, Honan, Sept. 15, 1947.

FIG. 14—Where the loess silt starts its journey to the Yellow River from central Shensi hills.



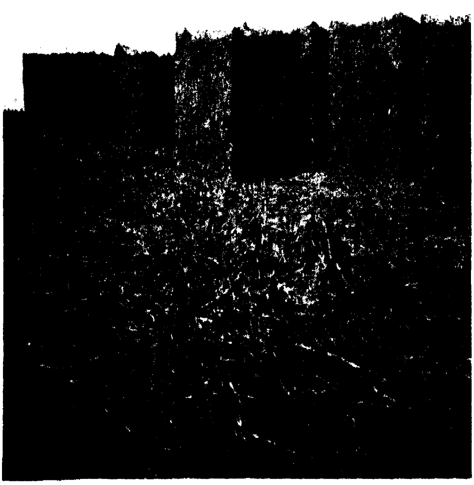


FIG. 15—The quarry at Luwangfen where white, soft limestone was procured for the rock-fill dam at Huayuankou.

FIG. 16—Stacks of kaoliang stalks (much like corn stalks) 10 feet high for use in closing Yellow River dike breaches.

FIG. 17—Loading "one-man size" stone at railway near quarry (see Fig. 15).

FIG. 18—Ice jam in western Shantung at Linpuchi, January, 1936.

Northward across the Yellow River we found a softer limestone in the old quarries at Luwangfen, close beside the tomb of Prince Lu of the Ming dynasty and less than two miles from the Peiping-Hankow Railway. Here for centuries workmen have quarried for paving stones and well uprights. In the villages of stone houses near by were workers accustomed to hand drilling of rock, though unfamiliar with foreign air compressors. We decided to use the Luwangfen quarries and to mix Western and local methods. More than 100,000 cubic yards of rock for our closure project came from these quarries. We used portable air compressors with jackhammers to speed up production. Capable young Chinese assistants were quickly trained to keep the equipment running efficiently under the general direction of an expert American operator. The maximum daily output of these quarries totaled 1200 cubic yards. All loading was done by hand into steel dump trucks or native oxcarts. As many as 300 small farm carts at a time, each drawn by two or three cattle, moved this rock to the railroad sidings, where it was stacked in piles for measuring and then carried on men's backs up sloping planks into flatcars or coal cars, and sometimes boxcars. After being hauled by rail nearly 60 miles to the closure site at Huayuankou each piece of rock was again handled four times by men using only their bare hands. Thus China's millions work today along the Yellow River.

Other local materials were brought in by the methods used through the centuries. Kaoliang stalks, millet straw, and willow branches for use in revetment work and cutoff dike cores came on slow-moving oxcarts, whose drivers had often traveled two full days over sandy roads from their farms in the flooded area north to the river, where the construction materials were weighed and paid for at rates too low to justify the long haul. But in China those benefiting from flood control give much in labor of men and oxen. It is a sort of reclamation tax paid in hard work. The floods of eight years had reduced the hemp-growing area, and hemp had to be brought in by train or truck from Hankow or Shantung or southern Honan. Patient workers twisted it into crude rope, using primitive twisting machines such as Confucius may have seen in these same districts. Rope in quantity was required to tie the bundles of kaoliang stalks used to protect the earthwork from the river current. Supplementing this rope was material of better quality from Manila and galvanized wire from America—60 tons of it—which was also twisted into light rope for tying back willow fascines at the toe of the dike.

Jute bags from India were used for sandbags, sometimes to weigh down willowwork and sometimes for waterproofing where loose earth would wash away too readily. Two and a half million bags, each containing 100

pounds or more of earth, went into this job in the winter of 1946–1947 and the following spring. From Oregon came 800,000 board feet of lumber, which was used for the trestle from which the rock-fill dam was built and for the camp to house the supervising staff. Nearly a thousand pieces of Oregon-pine piling, 45 to 70 feet long, made rapid construction of the trestle possible. To use concrete in the project would not have been economical. Use of Western draglines for excavating in the dry bed of the old course also would have proved impractical, though an order had been placed for them. Chinese picks, shovels, hoes, wheelbarrows, carry poles, and willow baskets were the tools used by 40,000 farmers to excavate 4 channels from 2 to 10 miles long, 60 feet wide, and 5 to 6 feet deep. There were no roots, stumps, or stones to interfere with the digging, which was usually dry or slightly damp. In a land of semifamine unemployed men need work to live, and in China it is human power that makes things move on the land and along the riverbanks. Here the population problem asserts itself and pushes the machine age as we know it in America into the future.

The Transportation Problem

Country roads in China are still poor by American or European standards. Those of North China are rarely surfaced. In the Chenghsien and Kaifeng region and to the south sand is often a problem—sand that poured from the bed of the Yellow River in prehistoric dike breaks and in the break of 1887–1888.[4] In early spring and summer mud becomes a serious problem when heavy showers make main roads such as that from Chengchow to Huayuankou impassable at times even for jeeps. As a rule the bridges are unsuitable for heavy trucks; often sections are washed out by mountain freshets. Nowadays, as in former times, local oxen are called upon to drag an auto from a muddy stream bottom where fording had been attempted. It was over such roads that the kaoliang stalks, willow branches, millet straw, and native timbers came to the closure work at Huayuankou.

The rail haul from Shanghai to the project was over four main lines and an eight-mile spur built by our construction organization to connect the closure area with the Peiping-Hankow Railway. Nothing wider than 14 feet could be shipped because of narrow bridges. The roadbeds were poor as a result of bad upkeep during the war; ballast was lacking, and the ties were rotting. Trains had to move slowly to avoid derailment. Civil war frequently caused delays, as when the Tientsin-Pukow Railway was cut by raiding

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[4] This is the only historical break of definite record that took the full flow into the Hwai River along the 1938 course. Most of the historical breaks of importance took place east of Kaifeng.

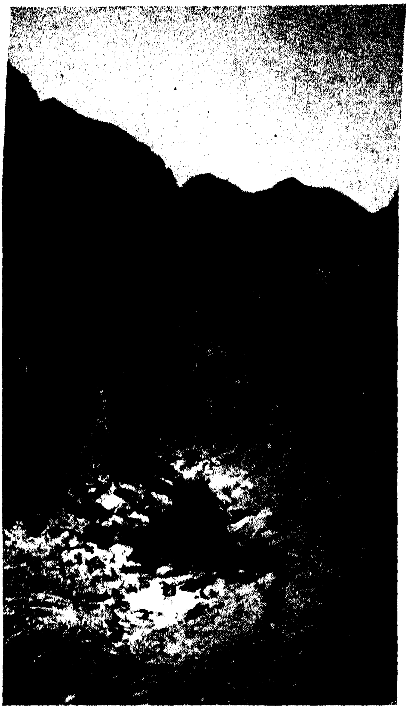

FIG. 19

FIG. 20

FIG. 21

FIG. 19—The heavy silt-bearing King River in low-water stage at the Wei-Pei irrigation intake.

FIG. 20—Refugees traveling over the long road among loess hills of Honan and Shensi.

FIG. 21—Rest period on a steep hill; refugees traveling on foot and with wheelbarrows through Honan and Shensi.

parties in the vicinity of Pengpu or the Lunghai line was torn up east of Lanfeng. Nevertheless, more than 100 trains made the trip to Kaifeng, Chengchow, and Huayuankou, with comparatively light losses, carrying 11,000 tons of construction equipment and materials (foreign) and 5000 tons of American flour, which was used as part pay for the workmen (2½ pounds to a man daily). An additional 20,000 tons of flour went to the men working along the 400 miles of dikes to the sea where repairs were needed. At times as many as 350,000 farmers and villagers took part in the repair work in Honan, Hopei, and Shantung, but the large mass employment for short periods was in Shantung. UNRRA undertook to furnish daily rations of flour to all these men and to haul it over railroads that were badly battered by eight years of warfare.

Transport by boat on the Yellow River was impractical except on a small scale because of the civil war and the loss of boats in the war with Japan. After the diversion of the river in March and April, 1947, few good vessels were available for moving stone downstream to Chakow, 20 miles below Huayuankou. The old high-sided cotton boats were no longer to be seen. Many of the old river junks were now engaged on the Hwai River.

The estimated 30 million refugees that had trekked west from the coastal plains to escape the Japanese armies moving into China went on foot for the most part, carrying their few possessions in wheelbarrows, on carry poles, or on donkeys. A few had carts, some could afford tickets on auto busses, others piled on the trains of the Lunghai Railway. The main motor and cart road leading west from Chenghsien through Loyang to Tungkwan and then to Sian was a scene of continual activity. And it was along this same path that millions returned to Honan in 1946 and 1947. It was to help prepare more land for these returning farmers to till that the Yellow River was put under better control.

Reclamation of Flooded Area

One of the means used by UNRRA to aid the returning farmers was mass plowing by tractors wherever large flat areas could be found. Most of the foreign operators that set up the tractor training stations for young Honanese were volunteers from the Church of the Brethren in Kansas and adjoining states. Several experimental demonstration stations were located in the region east of the Peiping-Hankow Railway 80 to 100 miles south of Chenghsien and Kaifeng. The rapidity of the work made it possible for the returning refugees to plant at once. But as more people came back to rebuild huts in the abandoned and flooded area of 1938, hoes were put to work in the usual way when plows were not available or animals were too few to pull

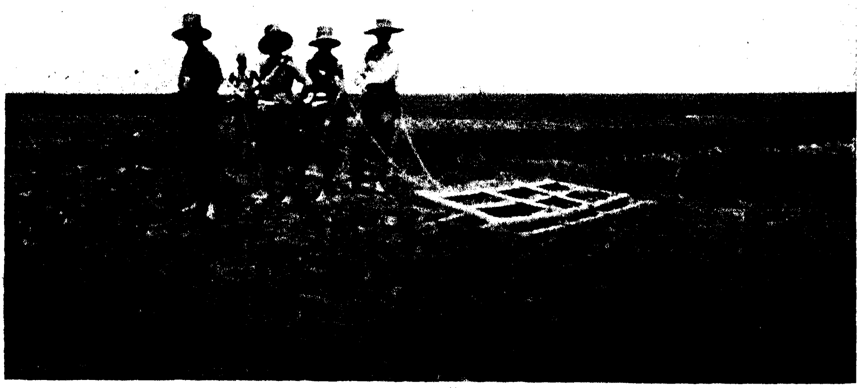

FIG. 22—Along the main street of a Shantung village swept by a Yellow River flood.
FIG. 23—Replanting a flooded area after the dike break is repaired; west Shantung.
FIG. 24—Reclamation of lands that were flooded. Men replace the livestock lost in the war.

FIG. 25—The first harvest in a village of west Shantung swept by the flood of 1935.

FIG. 26—Wheat harvest scene in Honan near the Yellow River; UNRRA jeep at left.

FIG. 27—Squatter's village in old bed of Yellow River, Shantung. Houses have kaoliang stalk sides and millet straw roofs, brick columns, mud roof plastering.

them. So the summer of 1947 saw much of the region which had been flooded by the Yellow River again under cultivation.

Eight years of flooding leaves its mark on farmland, especially where the overburden of silt is great. The Yellow River drains 300,000 square miles of mountainous country, much of it covered with a thick mantle of easily eroded loess.[5] Near the main channels of flow in the 1938 diversion area fine sand had been deposited.[6] Here was a problem of crop selection for a number of years to come. Where the sand deposits were deepest, peanuts would be planted. Beyond the sand deposits, silt might be found in thin layers or even to great depths in old depressions. As a rule this new soil was fertile, especially if it came from topsoil washed off Shensi hills. But if it was clay, such as underlies much of the loess deposits of Shensi and Kansu, then it might be far less valuable to the Honan farmer. Studies yet to be made will determine the losses and gains to the farmlands of Honan, Anhwei, and Kiangsu as a result of the diversion of the Yellow River in 1938.

Fortunately, the refugees could return to the Great Plain at a time when wheat, cotton, corn, beans, kaoliang, and millet could all be easily grown—it was not a drought cycle.[7] Rains were moderate, and the land was still wet from years of soaking. The drainage channels, in fact, had been badly silted up and had to be cleaned out. The farmers were subsidized by UNRRA with the usual daily 2½ pounds of flour to a man in late 1947 while the channels were being cleaned so that the flow from the high lands of western Honan would pass on quickly into the Hwai River system. That made it possible to plant late-summer and fall crops. Some farmers had already planted Chinese cabbage, turnips, radishes, and squash, all of which would supplement the fast-growing millet crop and help tide the people over a difficult winter. Then in 1948 all hands went back to farming much as in former years while trying to build livable dwellings. They are a tough people and, aided by a mild climate without really severe winters, they will rapidly recover the losses they have suffered through the wanderings of the Yellow River. Their war losses are another story.

A Comprehensive Program of Control

Those whose responsibility it is to keep the Yellow River under control

[5] P. G. Clapp: The Hwang Ho, Yellow River, *Geogr. Rev.*, Vol. 12, 1922, pp. 1–18.

[6] C. F. Hsi, P. Y. Cheng, and C. S. Tseng: Soil Problems in the Yellow River Flooded Areas, *Soils Quarterly*, National Geological Survey of China, Vol. 6, 1947, pp. 29–37 (in Chinese, with summary in English, pp. 36–37).

[7] See the general picture of climate and crops in Kiangsu in Huan-yong Hu: A Geographical Sketch of Kiangsu Province, *Geogr. Rev.*, Vol. 37, 1947, pp. 609–617.

would like to see carried out a comprehensive program that would offer protection from even the rare 1,000,000-cubic-foot flood. Fragmentary studies date back to 1918 and 1919, when the Grand Canal Improvement Board and the Chihli River Commission, with offices in Tientsin, began systematic, dependable investigations. Interruptions impeded the work, and not until 1933 were gauging stations set up by the new Yellow River Commission, which, under the able management of Mr. Sigurd Eliassen, gave important data. For the next four years studies and field surveys continued, and the flow and silt studies especially were improved. Then the Japanese invasion drove the commission from Honan, and few valuable river data have been gathered since. However, to preserve existing records, early in 1938 all available data were carefully studied by Mr. Eliassen and myself and discussed in "The Yellow River Problem."[8] The following suggestions were made for a long-term flood-control plan for this river.

1. Detention basins west of the Great Plain to arrest temporarily, and to "iron out," the cresting flow of maximum floods.
2. Spillway flow into basins on both sides of, and near, the river in western Shantung.
3. A by-pass channel following the general course of the Tu Hai Ho from the Grand Canal to the sea north of the river.
4. Earth dikes and their protective works.
5. Channel regulation and fixing a selected course.
6. Control of soil erosion in Shansi, Shensi, Kansu, and parts of Honan.
7. Control of runoff by increasing the brush and forest cover in Shansi, Shensi, Kansu, and parts of Honan.

To carry through the necessary studies for improvements to the flood-control system as we left it in late 1947, several river engineers who have known the Yellow River intimately for at least five years would be needed. They would direct the survey parties who would gather further field data over a period of perhaps three years. The construction program, based on a well-thought-out plan, should cover five years or more. This would include merely the beginning of a suitable program for the control of soil erosion in the parts of the watershed known to be the heaviest silt producers—about 75,000 square miles, or 25 per cent of the total watershed. The necessary terracing might take from 25 to 50 years, according to China's ability to finance the work. Shensi and Kansu Provinces are too poor, and it is in those two provinces that the heavy work of erosion control must be carried out. A tax on the lands of the Great Plain for flood-control insurance might be the solution. But it would be to China's advantage to go forward with a

Todd and Eliassen, *op. cit.*

comprehensive control scheme for Yellow River floods even before the silt load is materially reduced. The gradual reduction of the load through erosion-control measures would add the factor of safety to the system of control suggested here.

UNRRA helped put the river back into its best-protected channel and raise and repair the main dikes so that they are better today than in 1938, when the diversion to the southeast took place. The United Nations did not undertake to carry out any special work at the old delta to hold the mouth of the river within one or two well-revetted channels. That has never been done with the Yellow River and seems impractical at present. The main task was to restore the river to its prewar condition so far as possible and get the "flooded area" into crops again. This task was pretty well accomplished. A similar combination of efforts could insure the Great Plain for a hundred years, but it would take longer and cost much more. The fact that the lives and welfare of 50 million people are so closely tied up with this river's behavior makes the problem intriguing to engineers and intensely interesting to those who are studying population growth and the question of how the world is to be fed. In a way the Yellow River is a world problem in itself.

LAND UTILIZATION AND SETTLEMENT POSSIBILITIES IN SINKIANG

CHANG CHIH-YI

SINKIANG, known also as Chinese Turkestan, is the northwesternmost province of China. Its borders are China's frontiers with the Soviet Union, the Mongolian People's Republic, and India and the internal frontier with the Tibetan plateau. With an area of some 1,550,000 square kilometers, approximately triple that of France, Sinkiang has a population of only about 3,700,000—a density of 2.4 to a square kilometer. This low density has suggested to many Chinese economists and officials that part of the surplus population of China proper might be moved to Sinkiang as colonists. The province has been likened to the American West of the past century in respect to agricultural possibilities. But, as we shall see, Sinkiang has only modest resources, and political and social obstacles stand in the way of turning the vast empty province into a populous and prosperous area.[1] The findings of the Academia Sinica Expedition of 1943, with which the author was affiliated, provide fresh data for examining the possibilities.

Landscape and Climate

Sinkiang is bordered on three sides by mighty mountain masses and on the fourth side by wide stretches of barren plateaus. On the south, the lofty Kunlun ranges, with peaks of 24,000 feet, separate Sinkiang from Tibet and India; on the west are the difficult Pamirs, with peaks exceeding 20,000 feet. Between Sinkiang and the Mongolian People's Republic are the lower Mongolian Altai. On the frontier bordering on the Soviet Union on the northwest and north there are a few fairly accessible passes in the Alatai and Tarbagatai Mountains.

The province itself is a vast series of intermountain basins. The Tien Shan, extending from west to east through the center, divides it roughly into two natural regions: Jungaria in the north and the Tarim Basin in the south. Physically and structurally, the Tien Shan also forms a separate region, with a number of intermountain troughs, such as the Turfan Depression and the Kuldja Plain. By far the largest part of the Tarim Basin is occupied by a huge desert of drifting sand dunes, generally known as the Ta-

[1] "Sinkiang Survey," *Far Eastern Survey*, Vol. 17, 1948, pp. 53–63.

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klamakan, and one of the most formidable deserts in the world. No rivers flow from Sinkiang to the sea except the Black Irtysh, which drains northward into the Ob and thus into the Arctic Sea. The Akosu, Kizil, and Konche Rivers combine to form the Tarim.

At the foot of the mountains, between the drifting sand dunes and the hard boulder fans, lie the oases, ribbons of intensive cultivation and close settlement following the rivers and branching canals.

The Tarim Basin is one of the driest areas in the world. The primary cause of its aridity is to be sought in the mighty encircling mountain systems. Measurements are scanty. The mean annual precipitation at Kashgar is stated to be four inches.[2] Information collected by our expedition showed a rainfall of three inches at Kuche (1928–1930), 1.6 inches at Khotan (1942–1943), and 0.2 inch at Charkhlik (1928–1929). At Kuche, 60 per cent of the total falls in the spring (March to May inclusive); at Khotan, 72 per cent; at Kashgar, 60 per cent, and 15 per cent in September. Another salient feature of the dry climate is the high variability.

In the open desert rain falls even more rarely. The Taklamakan is "true" desert, as opposed to "tame" desert.[3] In the surrounding mountains precipitation is one and a half times as great as in the basin, according to the eminent Chinese meteorologist Dr. Lu Ch'iu, who bases his estimate on measured rainfall in the high mountains of the Nan Shan.

The precipitation in and around the Tarim Basin is so meager that it can hardly meet even the water requirement for grazing and forestry. Cultivation is absolutely impossible without irrigation. Both on the southern slope of the Tien Shan and on the northern slope of the Kunlun, there is no forest of any considerable size, and true pastures, also, are lacking.

The mean annual temperature in the Tarim Basin is not excessive. In consequence of rapid radiation under a cloudless sky, the temperature drops quickly at night. According to available data, the highest diurnal variation at Kuche, 64°F., usually occurs in June, the lowest, 56°, in December and January. Short-period means of temperatures (°F.) are:

	JAN.	APR.	JULY	OCT.	YEAR	PERIOD
Kashgar	18.7	55.9	78.1	50.7	50.9	1942–43
Khotan	19.4	58.1	77.7	52.9	52.3	1942–43
Kuche	6.8	55.8	75.1	48.2	47.8	1930–31

[2] W. G. Kendrew: The Climates of the Continents, 3rd edit., Oxford, 1937, pp. 182 and 224. M. Y. Nuttonson in "Ecological Crop Geography of China and its Agro-Climatic Analogues in North America," 1947, gives 2.2 inches as the mean for Kashgar for a 7-year period.

[3] L. Dudley Stamp: Asia: A Regional and Economic Geography, 3rd edit., New York [1936?], p. 568.

FIG. 1—Map of Sinkiang. Scale approximately 1 : 14,000,000. The southwestern boundary of Sinkiang shown by a dashed line is that given on recent maps of China received at the American Geographical Society. Discussions of the boundary question with India and Afghanistan and the U.S.S.R. have yet to be arranged. The northeastern boundary indicates claims (dashed line) by the Mongolian People's Republic. A map showing these claims appears in A. Murzaev's "The Mongolian People's Republic," Moscow, 1948, p. 168 (in Russian); it is also shown on the map accompanying Murzaev's article "The Sand Deserts of Mongolia," *Bull, USSR Geogr. Soc.*, Vol. 79, 1947, p. 85 (in Russian).

Spelling of the place names presents a problem. In general, the names on the map follow the nomenclature used on the American Geographical Society's map of "The World" prepared for the U. S. Department of State. In the text the more familiar names have been retained. Identifications not made on the map are: Yenki (Karashar), Yehcheng (Kargalik), Moyü (Karakash), Hotien (Khotan), Chohchiang (Charkhlik), Kuerhlei (Korla), Yutien (Kerya), Sulai (Manas), Wushih (Uchturfan), Wulukokiati (Ulugkhat), Chenghwa (Sharasume).

See also "Place Names in Sinkiang," U. S. Dept. of the Interior, Division of Geography [of the U. S. Board on Geographical Names], Mar. 26, 1945.

In summer the temperatures of the Tarim Basin are somewhat similar to those of subtropical Szechwan; the severe winter has many similarities to that of Kansu. The length of the growing season between the last killing frost in spring and the first killing frost in autumn is 220 days at Kuche.

The prevailing winds are from the east. Sir Aurel Stein, the eminent British explorer, found that "the convex side of the dunes generally faced to the west, a proof of the prevailing east winds."[4] From February to June the strong and destructive sandstorms blow, with a velocity from 60 to 70 miles an hour. Kashgar is particularly windy. In the spring the storms are usually accompanied by clouds of dust, which envelop the oasis in a haze.

For the rest of Sinkiang the climate may be divided into four types. The Jungarian basin is characterized by lower temperatures but more abundant and regular precipitation. The Kuldja Plain has abundant rainfall and mild temperatures. The northern highlands are marked by severity of weather and shortage of rainfall. The fourth type, exemplified by the Turfan Depression, has high temperatures and scanty rainfall. The following figures, from local meteorological stations, are illustrative:

	ELEVATION	PRECIPITATION	AVERAGE TEMPERATURE					PERIOD
	In feet	*In inches*	Jan.	Apr.	July	Oct.	Year	
Kuldja	2,100	11.0	18.5	55.2	73.6	52.7	49.1	1941–43
Urumchi	3,000	9.0	5.7	50.0	75.5	44.1	42.3	1937–43
Chenghwa	1,500	5.8	9.9	49.6	69.6	44.1	41.0	1941–43
Turfan	−49	1.2	19.2	59.9	92.7	58.3	58.8	1939–43

The growing season at Urumchi is recorded as 129 days; at Chenghwa it appears to be about 4½ months; and Kuldja resembles the Tarim Basin in length of time free from killing frost.

The Soils

On account of the shortage of rainfall, the dryness of the air, and the high diurnal variation in temperature, mechanical rock weathering as shown by the disintegration of granite and gneiss is commoner in Sinkiang than chemical weathering. The higher water table, however, leads to the building of alkaline soils in some areas beyond the alluvial fans, where a surface concentration of soluble salts is formed.

On the north side of the Tien Shan sand dunes or desert and alkaline

[4] M. Aurel Stein: Ruins of Desert Cathay, 2 vols., London, 1912; reference in Vol. 2, p. 384.

soils occur in areas farthest away; chestnut soils appear on the gentle slopes at the base of the mountains; brown forest soil is found in the forest zones; and, finally, near the top of the range, there is nothing but immature soils with disintegrated little-altered rock. On the south side of the Tien Shan, in areas farthest away, are deserts or sand dunes and desert soils; between the drifting deserts and the boulder fans alkaline soils are widespread in the lowlands and alluvial soils in the uplands; near the base of the mountains are desert pavements or desert soils; the piedmont is covered with barren rocks or immature soil on exposed slopes and low hills and with light-colored chestnut or alkaline soils in hollows among the hills; at higher altitudes brown forest soil and grassland soil occur.

The lower part of the northern slope of the Kunlun is similar to that of the southern slope of the Tien Shan; on the upper slope, however, there is no forest, and the soils are chiefly immature and morainic.

A physical and chemical anlysis made by Professor S. T. Huang reveals the following soil groups:[5]

Alluvial Soils. Alluvial soils are common in the oases of the Tarim Basin, such as Kuche, Akosu, Kashgar, Yarkand, and Khotan. According to the parent materials, they may be yellow, brownish, reddish brown, or grayish yellow; the texture ranges from sand to clay. A common characteristic is the calcareousness. Two profiles follow:

		1. *A Paddy Field, Akosu*		
0–15 cm.	Brownish	Clay loam	*p*H 7.2	Little humus
15–30 cm.	Brownish	Clay loam	7.3	
30–60 cm.	Grayish yellow	Clay loam	7.4	Disintegrated muscovite
		2. *Kargalik Oasis*		
Surface soil	Grayish, brownish	Silty clay loam	7.4	

All the Tarim Basin alluvial soils tend to become alkaline after irrigation wherever drainage is poor.

Chestnut Soils. Chestnut soils are found in the Jungarian basin and the Kuldja Plain. In color they range from dark brown to light brown. Short grass is the typical vegetation. Soils with thin layers are suitable only for grazing, but soils with thick layers can be used for dry farming. An analysis of a sample taken from Kuldja shows a light-colored soil, containing little humus, *p*H value 7.3, with pebbles closely underlain by shales underneath the surface soil.

Alkaline Soils. Alkaline soils occur in lowlands where there are difficulties in drainage. They are found (1) between Karashar and Luntai; (2) in Karashar, Yangi-hissar, and Yarkand, where alluvial soils became alkaline because of the rise of the water table; (3) along

[5] S. T. Huang: Soil and Soil Conservation in Sinkiang, *P'ien-cheng kung Lun* (*Frontier Affairs*), Oct., 1944, pp. 24–32. (In Chinese.)

both shores of the Khotan and Tarim Rivers. Soil reaction of some alkaline soils in some cultivated fields in Karashar reaches 7.5 in *p*H value, which is considered mildly alkaline. Their productivity for crop plants is low.

Desert Soils. Desert soils cover the oases of Hami, Shanshan, Turfan, and Tokosun. They are low in organic matter, yet fertile if irrigated. Soil reaction is 7.3 in *p*H value.

Population

In 1940–1941 the provincial government of Sinkiang made a population survey, according to which the total population of Sinkiang Province was 3,730,051, of whom 75 per cent lived in the Tarim Basin.

The non-Chinese-speaking people constitute a majority of the population of the province. The ethnic distribution of the population is roughly: Uigurs, 80 per cent; Kazaks, 9; Chinese, 5; others, 6.

The ethnic composition of various regions and the geographical distribution of various ethnic groups (*italics*) are thus, in percentages:

	Urumchi		Kuldja		Chuguchak		Altai		Tarim Basin	
Chinese	36	*66*	6	*10*	16	*11*	4	*1*	1	*12*
Uigurs	35	*5*	24	*3*	6	*1*	4		95	*91*
Kazaks	12	*14*	36	*43*	54	*24*	86	*17*	1	*2*
Others	17		34		24		6		3	

Both the Uigurs and the Kazaks speak Turkic languages and adhere to Islam. The Uigurs are oasis dwellers, whose main occupation is farming; the Kazaks are nomads, famous for their horsemanship. Other non-Chinese population groups are the Kirghiz, the Kalmuks, the Tajiks, and the Tungus. The Kirghiz and the Kalmuks are nomadic herdsmen. The Chinese are the ruling minority, dominating the bureaucracy and the military forces; most of them are engaged in farming, a few have taken up moneylending and caravan trade.

The population of the Tarim Basin, with its predominance of Uigurs, is far more homogeneous than that of northern Sinkiang. Furthermore, the conflict of interests between the Uigur farmers and the small Kirghiz nomad minority is mitigated, and social life stabilized, by their economic interdependence. The Uigurs are in need of livestock raised by the Kirghiz; the Kirghiz depend on the Uigurs for *matta,* a kind of coarse cotton cloth.

From the beginning of the seventeenth century to the middle of the eighteenth Jungaria was inhabited exclusively by the Jungars or Kalmuk Mongols. The great massacres of 1755 to 1758, carried out by a Manchu-led army, depopulated the country, which was then open to possible Chinese

colonization. The Chinese soon outnumbered the remnants of the Kalmuks. Some Uigurs were also removed by the Manchu administration from the Tarim Basin to Jungaria. As a result, the ethnic diversity of Jungaria began to take shape. In the eighties and nineties of the last century a large number of Kazaks living in Russian territory moved into Jungaria. They have rapidly grown into a major population group, second in numerical importance only to the Uigurs. At present Jungaria is inhabited by mixed groups of Chinese, Uigurs, Kazaks, and Kalmuks. In the regions of Kuldja and Chuguchak the Kazaks rank first in number among all ethnic groups.

In Jungaria the ratio of farm population to nomadic population is roughly 1 : 1.6. The conflict of interests between the agricultural Chinese and the nomadic peoples on the one hand, and between nomadic Kazaks and nomadic Kalmuks on the other, is the keynote of the dynamics of the frontier society. Social unrest in Jungaria is further aggravated by the lack of any considerable trade between the Chinese and the nomads. The Chinese peasants, who are well stocked with both draft and meat animals, make little, if any, demand upon the livestock of the nomadic herdsmen. Similarly, the nomads buy nothing from the Chinese except a small quantity of grains.

In spite of recurrent massacres carried out by one ethnic group against another, Sinkiang's population has shown a marked tendency of growth. The *Sinkiang Gazetteer* reported a population of 2,003,931 in the period 1882–1902.[6] As against the 1940–1941 population of 3,730,051, that means an increase of 1,726,120 in a 40-year period. An estimate puts the immigration of Kazaks, Chinese, and other groups in the same 40-year period at about 350,000. The difference of 1,376,120 is therefore accounted for by the natural growth of population. The predominance of children as compared with old people in the age structure in Sinkiang can be taken as a good indication of the long-run trend of population growth.

The question arises how a growing population can be supported by the oases of Sinkiang, which many geographers are inclined to think are shrinking in size.[7] In the opinion of Schomberg and Lyde, however, the oases have become more extensive as they have moved closer to the skirt of the foothills to take advantage of the more abundant water supply.[8]

[6] Wang Shu-nan, *Sinkiang Gazetteer*, chüan 1, pp. 5–7. (In Chinese.)

[7] Erik Norin (Quaternary Climatic Changes within the Tarim Basin, *Geogr. Rev.*, Vol. 22, 1932, pp. 591–598) states categorically that "the investigations of travelers of many nations have given abundant proofs of a progressive desiccation of certain portions of the Tarim basin during historical time" (p. 597).

[8] R. C. F. Schomberg: Alleged Changes in the Climate of Southern Turkistan, *Geogr. Journ.*, Vol. 80, 1932, pp. 132–144; reference on pp. 134 and 144.

Agricultural Regions

According to land utilization and the kinds of crops and times of harvest, Sinkiang can be divided into the following agricultural regions:

A. Grazing Regions
- 1. Northern Highlands
  - *a*) Tall-grass prairie north of the Black Irtysh River up to the Altai Mountains
  - *b*) Tall-grass prairie west of the Irtysh up to Chuguchak
  - *c*) Grasslands on both banks of the Emil River
- 2. Northern slope of the Tien Shan
  - *a*) Mainly the lower slope where the layer of chestnut soils is thin
- 3. Kuldja Region
  - *a*) The lower Kunges, a wide, level valley with abundant pastures
  - *b*) The Tekes Valley
  - *c*) The Borotala Valley
- 4. Karashar Region
  - *a*) The Yulduz Valley

B. Farming Regions
- 1. Single-cropping winter-wheat region
  - *a*) Jungaria
- 2. Single-cropping spring-wheat region
  - *a*) Kuldja
  - *b*) Kuche
  - *c*) Karashar
  - *d*) Charchan
- 3. Single-cropping wheat or rice region
  - *a*) Mainly Akosu
- 4. Cotton, sericulture, and two-year triple-cropping wheat and corn region
  - *a*) Khotan
  - *b*) Yarkand
  - *c*) Kashgar
- 5. Cotton and two-year triple-cropping wheat and kaoliang region
  - *a*) Turfan Depression

There is some grazing in the Tarim Basin but none in the Turfan Depression. The grazing in the Tarim Basin, on a small scale, is carried on by Kirghiz in Wushih, north of Akosu, and Koping, southwest; in Wulukokiati, west of Kashgar; and in some upper mountain valleys of the Yarkand, Khotan, and Charchan Rivers.

Winter wheat, which cannot be raised in Kuche and Karashar, grows in much colder regions in Jungaria, because of the protection afforded by the snow cover. In the regions that give three crops every two years, rice is also raised, but with only one harvest a year; it is sown in March and harvested in July. Triple cropping every two years involves the rotation of crops. For instance, in Khotan in the first year from the middle of March to the middle of April spring wheat is sown, and after it is harvested in August, corn is sown, which is reaped in November; in the second year, only corn is raised, but it is sown and harvested earlier.

The chief regions of cotton production include Merket, Khotan, Yarkand, Karakash, Kashgar, Akosu, and the Turfan Depression, with Suilai as the northern boundary of the cotton belt. Cotton is sown in the middle of April and picked in September.

Nomadic Grazing

Grazing is carried on by the Kazaks and Kalmuks, who depend entirely on the natural grasses as feed for their herds. Hay is rarely used for winter feeding. Among the pasture grasses the hardy, long-lived *Stipa splendens* has the same relative importance in grazing that wheat has in farming.

An approximate estimate of livestock in 1943 in Sinkiang is: sheep and goats, 11,720,000 head; cattle, 1,550,000; horses, 870,000; camels, 90,000. The total number of livestock is almost as great as that in the nomadic regions of the four northwestern provinces (Suiyuan, Ningsia, Chinghai, and Kansu) taken together.

Of the total livestock, possibly about two-thirds are raised by the nomads. The pastureland of Sinkiang totals some 160,000,000 acres. Thus it takes some 10 acres of pasture to maintain one head of stock (nomad) in Sinkiang, as against the 15–25 acres required to support each beef cow on the Great Plains of North America.[9] These figures suggest that grazing in Sinkiang is a more intensive form of land utilization than is generally ascribed to nomadic peoples.

The nomads usually tend several kinds of animals, but sheep are the commonest. In a sense, sheep fit best into the pattern of subsistence stock raising, because they supply not only meat and milk but also clothing and materials for shelter, and sheep dung is much used as fuel. In fact, sheep raising in Sinkiang presents a pattern of commercialized nomadic grazing. In contrast with the nomadic regions of Kokonor, where the mixed type of sheep is dominant, Sinkiang breeds two specialized varieties, a meat type in the north and a wool type in the south. The Kazaks raise sheep of the meat type mainly for sale; the demand comes in large measure from consuming centers in Soviet Turkestan.

There are two types of nomadic grazing. The one is an aimless roaming, the routes varying from year to year. This type of nomadism, though still practiced by some Kirghiz, is losing in importance on account of the shrinkage of pastures. The other type has definite encampments for summer and winter pastures. To wander about the steppes without a fixed plan would be impossible with herds as large as those of the Kazaks or the Kalmuks, because of the inevitable clashes between neighbors. A tribe regards a certain territory as its property and brooks no intrusion.

Commonly, conflicts between herdsmen or between herdsmen and

[9] C. F. Jones, in collaboration with G. G. Darkenwald: Economic Geography, New York, 1941, p. 119.

oasis dwellers are due to rivalry over winter quarters. But in Sinkiang, at least among the Kazaks in the Altai and Chuguchak, this is not the case. The Kazaks here are short of summer encampments because the summer pastures are infested with mosquitoes. This explains why most Kazaks have to migrate southward as far as Barkul, Kitai, and other oases of Jungaria to search for summer quarters; and, as could be expected, conflicts arise between nomads and oasis dwellers.

Feudal relations exist between nomads and their chieftains. Share stock raising, which represents an economic survival either of slavery or of feudalism, is prevalent in Sinkiang. The "absentee" masters, who usually live in cities or camping centers, lease their herds to the poor nomads. The increase in the number of animals is turned over to the owner as rent.

Dry Farming and Irrigation

In Jungaria dry farming is practiced to a certain extent: the fields under this system form 15 per cent of the total cultivated area. Kuldja and Kitai, Muleiho, and some other Chinese settlements in eastern Jungaria are known for their unirrigated crops.

Land under dry farming is usually steep and unsuitable for irrigation without laborious terracing. In Kuldja drought-enduring crops such as barley, millet, and even wheat are raised, but because of the high variability of rainfall the yields are uncertain, and in some years there is almost no harvest. Possibilities for expansion of dry farming in Sinkiang seem very small.

In the Tarim Basin almost all land utilization depends on the availability of water. The fields under dry farming total only 12,000 acres, of which more than 10,000 acres are in the oasis of Korla. In contrast with Jungaria, only flat alkaline lowlands where subsurface water wells up are used for dry farming in Korla. In a sense, dry farming as practiced in this oasis is akin to the farming under "natural irrigation," in which fields are fed by rainfall.

Rain, the "mercy of Allah" in Persia, is the opposite in the Tarim Basin. If there is rain in the spring, the sun is obscured, and the rainfall is unable to compensate the loss of the water created by the melting of snow in the heights. We were told that in 1931 there was more rainfall than usual in Khotan, but a shortage of water occurred notwithstanding.

The water for irrigation comes from mountain snow, springs, and underground water. In Kashgar 80 per cent comes from snow and 20 per cent from springs. From the melting glaciers or high snows rivers flow down into the basin and are spread out through the network of irrigation

canals made possible by the gentle gradient. The Khotan Darya may be taken as an illustration. The mountain snow begins to melt in March; the river reaches flood height in June and July and then begins to decrease; when the water is diverted almost entirely to the irrigation channels in September and October, the river becomes dry.

Springs provide water in small quantity but with dependable regularity in many localities in the Tarim Basin and Jungaria. Some small oases, such as Kumish, south of Tokosun, rely entirely on this source.

Many streams in the Tarim Basin and the intermountain basins of the Tien Shan disappear in the boulder fans before reaching any oasis. The subterranean flows commonly re-emerge in or beyond the oases and form the most important type of subsurface water in Sinkiang. Ellsworth Huntington found that about 40 per cent of the population of the Turfan Depression was dependent on the utilization of subterranean flows in the form of *kariz*.[10] There is no doubt that subterranean flows have not been fully utilized in the Tarim Basin.

Nearly all irrigation channels are dug by collective effort. The water right of each farmer is in proportion to the quantity of labor he contributes to the digging and repairing of the irrigation channels and the discharge of water for irrigation. In Kucha, one who originally contributed one *ketman* of labor is entitled to one *ketman* of water, which is sufficient to irrigate six hectares of crop fields.

Disputes over water rights usually occur in the spring, when each cultivator wishes to water his land first in order to get an early crop. Some localities are troubled by quarrels between the upper and lower parts of a river. Disputes between Yarkand and Merket, for instance, have lasted for 25 years.

Among the Uigurs, irrigation regulation is entirely a matter of self-government. *Mirab,* whose office is to keep proper registers and who are in charge of the distribution of the water of the main irrigation channels, are chosen by the villages. *Kokbeshi*, assistants to the mirab, are empowered to superintend the distribution of water within a village. Most irrigation agents are paid in kind by farmers. Moslem churchmen also exercise some authority over irrigation regulation.

An irrigated agriculture means a stable agriculture. Chinese historical records testify that during the past 70 to 80 years no famine has occurred in Sinkiang. In this respect there is a marked contrast with China proper, which has been under constant threat of drought, floods, and famines.

Ellsworth Huntington: The Pulse of Asia; Boston and New York, 1907; p. 311.

Farm Crops

Within any oasis diversified farming is the rule. The rare cases of specialization are the truck farming carried on by Chinese immigrants from Tientsin in the vicinity of Urumchi for local demand and the grape culture in some mountain gorges of Turfan for export. There has also been a trend toward specialization in cotton in the chief cotton-producing regions, such as Merket, Yarkand, Turfan, and Karakash.

In diversified farming, grain production ranks first, though horticulture is of considerable importance. Stock raising as a side line is much more important in Jungaria than in the Tarim Basin. Cotton is widely produced in the Tarim Basin and the Turfan Depression. Home-handicraft cotton spinning and weaving are closely linked to farming.

In establishing his farm balance, the Uigur peasant tries to keep pace with changing market conditions. "Diversified farming" is by no means synonymous with "a closed economy." As a consequence of the development of trade with the Soviet Union, a certain amount of commercialism has become prominent in Sinkiang. A considerable part of the cotton, matta, raisins, apricots, and silk is earmarked for sale, chiefly for export to the U.S.S.R. Because of its dependence on external trade, Sinkiang suffers when these exports to Russia are shut off, as in the recent disruption of trade relations with that country.

The farmer has to take into consideration the water and fertilizer requirements of various crops. With a limited water supply he is not able to devote too much land to crops that have a high water requirement. For example, the American long-staple cotton needs much more water than the native short-staple variety; hence it fails to dominate Sinkiang's cotton production notwithstanding its superior quality. Similarly, the scarcity and high cost of fertilizers make it necessary to consider the requirements of various crops as well as the system of crop rotations in deciding on particular crop combinations.

Wheat ranks first among grain crops in both acreage and production. Next come corn, rice, kaoliang, and barley. Indian corn was introduced about 1550 by Moslem pilgrims from Mecca, whereas it did not appear in China proper until the seventies of the sixteenth century. Rice is also a centuries-old crop in Sinkiang: the Chinese pilgrim Hsüan Tsang, who traveled across Sinkiang in the seventh century, mentions rice culture.[11]

[11] Hsüan Tsang: Ta T'ang Hsi-yu chi, 1909 edit., chüan 1, p. 6. (In Chinese.) There is an English version, "Si-yu-ki: Buddhist Records of the Western World, Translated from the Chinese of Hiuen Tsiang (A.D. 629)," by Samuel Beal, 2 vols., London, 1906; reference in Vol. 1, p. 19.

The total area of the five principal grain crops is about 1,173,000 hectares (2,900,000 acres); the total production in 1942 was 7,000,000 quintals, of which wheat made up 44 per cent, corn 28 per cent, and rice 6 per cent.

The natives of Sinkiang measure the productivity of land in terms of units produced for each unit sown. The ratios in the village of Shkon, four miles north of Yarkand, are: wheat, 5:1; rice 20; corn, 20–50.

In Turfan wheat is said to have yielded as much as 40–46 times the original planting. Schomberg is justified in putting the average yield of wheat to the seed sown for the Tarim Basin at 12.[12]

The common method of evaluating the productivity of land is, of course, in terms of yield per unit of land. The average yields per hectare in kilograms in Kargalik are: wheat, 352.5; rice, 532.5–720; corn, 532.5–1088.

The yield of wheat in Kargalik is only five bushels to an acre, far below the weighted average world yield (1920–1934) of 13.8 bushels.[13] The lower yield of rice as compared with corn might be explained by the fact that the Uigurs do not transplant young shoots as the Chinese peasants do. On the whole, the yield of food crops in Sinkiang is much lower than in China proper.

Farming Practices and Labor

The native plow consists essentially of a large pole tipped with three or four inches of iron and attached to a yoke borne by a team of animals. In the Kuldja and Chuguchak areas Russian improved plows are being used to a certain extent. The common draft animal is the ox. In general, Sinkiang peasants are well supplied with draft animals. However, in some localities of the Tarim Basin work cattle are lacking; in one village in Kargalik, for example, about 20 per cent of the peasants had none at all and had to rent them when needed.

Fertilization and intertillage differ in the Tarim Basin and in Jungaria. In Jungaria everything except irrigation is left to the mercy of Allah. The fallow system is widely practiced. On large farms land allowed to lie idle each year constitutes about half the cultivable area, on small farms about a third. In the Tarim Basin, on the other hand, fallow is rare even on large landed estates. Except on lands too far from the cities, fertilizers in the basin are mainly in the form of night soil, and as the cities are the centers of the supply of night soil, the degree of intensity of fertilization, and of

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[12] R. C. F. Schomberg: The Habitability of Chinese Turkistan, *Geogr. Journ.*, Vol. 80, 1932, pp. 505–511; reference on p. 507.

[13] M. K. Bennett and H. C. Farnsworth: World Wheat Acreage, Yields, and Climates, *Stanford Univ. Food Research Inst. Wheat Studies*, Vol. 13, 1936–1937, pp. 265–308; reference on p. 280.

farming, varies with the distance from them. Intertillage in the Tarim Basin is confined to the paddy fields. The widely used farm implement for intertillage and for digging canals is a broad, heavy mattock, called a *ketman*, probably introduced into Chinese Turkestan from India.

Crops are cut by hand with the scythe. Threshing is done by the very primitive method of driving oxen to trample on the grain on a threshing floor of beaten earth.

In terms of input of labor, the agriculture of the Tarim Basin is highly intensive. According to a survey made by us in the village of Kumshlak, Akosu, the labor input per hectare of paddy field exclusive of that required for irrigation ranges from 86 to 92 labor days; the corresponding figures for China proper, based on the study of J. L. Buck,[14] are 126 labor days for early rice and 57 labor days for late rice.

LANDOWNERSHIP

According to a survey made by us in the village of Yavah, about two miles south of Kargalik, among the 576 landowners the average holding is 1.34 acres, which is even smaller than the unusually small holdings in Chekiang Province; the largest holding is 54 acres, the smallest 0.025 acre. About 20 per cent of the households in Yavah are without land; about 70 per cent of the land is concentrated in the hands of only 25 per cent of the rural population. For the total population of 706 households the cultivated area amounts to 1.1 acres to a household.

In Khotan the average landholding is 2.5 acres; in Karakash, 3.7 acres. In Jungaria it is much larger—8 acres in Kuldja and 32 acres in Urumchi.

In the village of Yavah, of the total population, full tenants make up 19.5 per cent; part tenants, 22 per cent; full owners, 57 per cent; landlords, 1.5 per cent. There are two kinds of tenancy. The dominant kind, called "cotillage," is somewhat similar to sharecropping in the United States. The owners supply land, water rights, and draft animals; the tenants contribute labor and in some cases a small amount of farm capital. The share of the harvest delivered to landowners ranges from 50 to 80 per cent. The cotillers are not tenants in the European, modern sense; they are semifeudal share tenants. In the other kind of tenancy all farm capital except land and water rights is provided by the tenant. The rent is paid in kind—"grain rent"—in a definite amount stipulated in the contract of tenancy.

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[14] J. L. Buck: Land Utilization in China, 3 vols. (text, atlas, statistics), Nanking, Chicago, etc., 1937; reference in text volume, p. 302.

Possibilities of Colonization

Chinese planners who look upon Sinkiang as an outlet for the excess agricultural population of China proper point to the province's low density of population of 2.4 persons to a square kilometer. But the traditional man-land ratio is woefully inadequate to convey the right meaning of population density in Sinkiang. It is better expressed in population to cultivated area.

According to a Soviet source, the cultivated area of Sinkiang amounts to 1,320,000 hectares or 3,260,000 acres,[15] which is about the total cultivated area of Vermont. Thus the density of population per square kilometer of cultivated area for the whole of Sinkiang is 283, and for the Tarim Basin alone, 320.

Apparently the ratio is not much lower in Sinkiang than in China proper. For instance, the corresponding figure for Szechwan, a densely populated province, is 309.[16] Only a few Chinese provinces—Shantung (560), for example—are ahead of Sinkiang. As regards cultivated area, therefore, Sinkiang is just as overpopulated as, if not more than, China proper; in fact, the Tarim Basin sends emigrants to northern Sinkiang.

The cultivated area of Sinkiang is only about 1 per cent of the total area. This is a surprisingly low degree of land utilization. Can it be raised?

The total discharge of Sinkiang rivers is estimated at about 3400 cubic meters a second. Schomberg contends that one-third to one-half of Sinkiang water runs to waste "throughout the irrigable year."[17] If the available discharge could be stored up, the total supply of surface water would be 107,283 million cubic meters a year. Since it takes 6600 cubic meters of water to grow crops—wheat and corn—on one acre of land, the maximum area that could be irrigated by Sinkiang's surface water would be 16 million acres, an area almost equal to the land in farms in New York State. To this we must add some 4 million acres under the assumption that full utilization of springs and underground water could be achieved in one way or another. Thus, given the most efficient and economical use of water supply, the total amount of land that could be irrigated in Sinkiang would be about 20 million acres.

In considering agricultural possibilities, attention must be paid not only to the water supply but also to the terrain. In regard to this, many misconceptions exist. Schomberg goes so far as to assert that the whole of the

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[15] *Serq Haqiqiti* (*The Eastern Truth*), Tashkent, Apr. 1, 1937. (In Uigur.)

[16] Based on Buck, *op. cit.*, text volume, p. 362.

[17] Schomberg, The Habitability of Chinese Turkistan. *loc. cit.*

Taklamakan desert is potentially cultivable. The fact is, however, that a considerable part of Sinkiang is unfit for cultivation because of unfavorable topography. Large tracts of the Taklamakan are covered with innumerable crescentic sand dunes, some as high as 300 feet, in constant motion like the waves of a choppy sea.

It may be argued that sand dunes have been successfully stabilized elsewhere—on Cape Cod, for instance.[18] But there are reasons for believing that the success on the Cape rests upon the abundant rainfall. This condition does not exist in Sinkiang. Water would have to be pumped up from rivers or reservoirs to irrigate one by one the millions of migratory dunes. To be sure, in Sinkiang one often hears of small settlements reclaimed from the desert; Malak-alagan west of Yutien and Helasi north of Karakash are examples. These places, however, lie within the semidesert zone, which, in contrast with the rugged and moving desert, is level and stable.

After taking due account of the terrain, we find unused arable lands in Sinkiang only in the following areas:

1. In narrow zones where the cultivated oases begin to fade into the true desert. Such a semidesert zone is usually covered with alkaline soils. Its typical vegetation is tamarisk, wild poplar, and reeds.

2. Along both banks of the Khotan, Yarkand, Kizil, Konche, and Tarim Rivers. Tracts with wild scrubs and alkaline soils occur here.

3. On some mountain slopes in Jungaria. The hill slopes in the Tarim Basin, however, are of no use because of their steepness.

To judge by Sir Aurel Stein's map, the semidesert tracts in the Tarim Basin total roughly twice the present extent of the oases. In Jungaria the semidesert belt around the oases is a little broader; we make it two and a half times as large as the oases. By this reckoning the uncultivated arable land of Sinkiang amounts to 2,730,000 hectares (6,746,000 acres), of which 1,600,000 hectares are in the Tarim Basin and 1,130,000 in Jungaria.

We have not included the better-watered pastures in Jungaria as part of the arable land. Such pastures could be turned into arable by proper drainage. But since this change would encroach on the interests of the nomadic herdsmen and lead to conflicts between population groups, it is hardly advisable.

In contrast with the limited possibilities of expanded agriculture that emerge from the foregoing analysis, extravagant possibilities are sometimes advanced. Schomberg's views are both fantastic and inconsistent. He con-

[18] K. J. Kucinski and W. S. Eisenmenger: Sand Dune Stabilization on Cape Cod, *Econ. Geogr.*, Vol. 19, 1943, pp. 206–214.

tends that proper irrigation in the Tarim Basin would double the yield and that good farming would add 50 per cent to this doubled yield, so that the average settled area should treble in size and therefore the population of the settled areas of Sinkiang could be increased from the present four million to 12 million. Then he proceeds to double Penck's estimate of 3,200,000 acres as the cultivated area of the basin[19] and to display skepticism toward his estimate that proper canalization of the Tarim and the Konche Darya would increase the cultivated area by only 1000 square miles (640,000 acres). Without elaborating his own opinion on the potentialities of arable land Schomberg jumps to the conclusion: "Penck hazards 40 millions as the maximum population for Central Asia . . . I should multiply this by four for the Tarim Basin alone."[20]

The population trend of Soviet Turkestan may throw some light on the potential population growth of its counterpart, Sinkiang. Soviet Turkestan has witnessed a great social and economic reconstruction in the past two decades. New irrigation schemes have been instituted. As a result of a project for dividing the waters of the Amu Darya in its lower course, 1,250,000 hectares (3,090,000 acres) of land are being reclaimed for farming.[21] What has been the effect on the growth of population? The population of Soviet Turkestan grew from 13,671,478 in December, 1926, to 16,626,760 in January, 1939. The increase was less than three million in 12 years and was, moreover, primarily among urban dwellers. In fact, in two of the Central Asiatic republics there was a decrease in rural population.[22] It may be inferred that: (1) Great though the agricultural possibilities of a country may be, they cannot be realized without industrialization. (2) When a country has become industrialized, increase in population will mainly take the form of urbanization. (3) The rate of population growth is likely to be slow, since the standard of living is raised.

It should be added that much of the uncultivated arable land in Sinkiang is alkaline and needs extensive and expensive reclamation and much of it is far from the present oases. From the economic point of view these lands might not appeal to new settlers at all. And the newly cleared lands might be used to enlarge the holdings of old settlers, and thus there would be no immediate increase of their population-supporting capacity. Besides, we

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[19] See Albrecht Penck: The Habitable Globe: Central Asia, *Geogr. Journ.*, Vol. 76, 1930, pp. 477–487.

[20] Schomberg, The Habitability of Chinese Turkistan (*op. cit.*), pp. 508–509.

[21] H. E. Adler: Turkistan in Transition, *Geogr. Journ.*, Vol. 107, 1946, pp. 230–235; reference on pp. 233–234.

[22] Kathleen Barnes: Siberian Population Mounts 30% in Twelve Years, *Far Eastern Survey*, Vol. 9, 1940, p. 8.

should not shut our eyes to the present political and social obstacles, which would frustrate any attempt at realization of such agricultural possibilities as there are.

Schomberg advances the argument that good farming alone would add 50 per cent to the yield in the Tarim Basin and thus support 50 per cent more population. Surely this is an open question; and there is little likelihood that, even if the increase in productivity of land were followed by population growth, both would increase at exactly the same rate.

That the land resources of Sinkiang can support more population does not mean that Chinese colonization in the province is possible. It is more soberly realistic to take a pessimistic view of the prospects of colonization in Sinkiang, for two reasons.

In the first place, there would be no room for Chinese settlers in the Tarim Basin and the Turfan Depression even if the idle land could be utilized. As has been shown, the average size of landholdings in Kargalik is about half a hectare to a household. Any newly cleared ground should be allocated to the Uigur peasants, who are hungry for land. It is quite probable that the natural growth of the native non-Chinese population will take up any reserves of land for new cultivation. To import Chinese would be to invite new conflicts. In the early thirties of the present century Chin Shu-jen, then governor of Sinkiang, tried to settle some eighty Kansu refugees in Hami, and, as a result, an uprising broke out among the Uigurs.

In the second place, any colonization by Chinese in the regions of Kuldja, Chuguchak, and Altai would be very likely to cause discontent among the nomads. The settlement of Honan refugees in those regions is believed to be the root cause of the recent turbulence among the Kazaks.

The possible areas for Chinese colonization are confined to the Jungarian basin and Hami and Karashar which have an approximate 1,500,000 hectares of unused arable land. If half a hectare of land is granted to each person (in view of the fallow system and the relatively low productivity of land in Sinkiang), 3,000,000 more Chinese, or almost 17 times the present number of Chinese in Sinkiang, is the maximum quota for Chinese colonization in the province.

The implementation of such a colonization program would depend on the solution of correlated problems. In the first place, large irrigation projects, which in turn call for the construction of a railroad, would be required. In the second place, the present deficiencies of livestock and fertilizers, which are almost as serious as the deficiencies of water supply in the Tarim Basin, would have to be overcome. In the third place, since the oasis dwellers

depend on the wild growth on the idle land for fuel, a new source of fuel supply would have to be obtained. Finally, in view of the archaic agrarian relations, land reform would also be necessary; without it the migration of large numbers of poor peasants to Sinkiang would merely result in spreading landlordism.

The immigration of the Chinese dates back to 1776, when an imperial edict provided for a subsidy for those who were ready to settle themselves in Sinkiang.[23] After that, a considerable number of Chinese moved in, until finally a point of saturation was reached at the beginning of our century. Colonization in Sinkiang has had a sad history during the past three decades, and there appears to be little prospect for Chinese colonization in the territory in the future.

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[23] Wang Sien-chien, Tung Hua Lu (Collection of State Papers), Imperial Edict of June, 1776. (In Chinese.)

A PROGRAM FOR JAPANESE FISHERIES

ADA ESPENSHADE

THE fishing industry is considered by many to be a major key to Japan's food problem. The Japanese excel in fishing; with encouragement and the solution of the present difficulties in obtaining certain needed supplies, the fishing industry, it is asserted, can make up a large part of Japan's food deficit. And, since proteins and fats are particularly lacking in Japanese food today, increased consumption of fishery products, which are high in protein and supply some fats, will also result in a better-balanced diet.

Is such optimism justified? It must first of all be asked whether the fishery resources available to Japan will permit increased production. If Japan is restricted to its present fishing area (Fig. 1), production can be substantially increased only at the cost of further reduction of resources that already show indications of overuse—a temporary gain will lead to future loss. If, on the other hand, Japanese fishermen are allowed to expand their area of operations, they can increase production considerably, but such expansion can be achieved only in the face of strong opposition on the part of other nations, particularly the Soviet Union, Australia, and China. Use of other possible areas will meet with the resistance of expanding American fishing interests.

PREWAR FISHING

Before World War II, Japan held first place among the nations of the world in fishing. During 1931–1938, when fishing operations were at their peak, Japan's annual production ranged from 3,500,000 metrics tons to 4,500,000.[1] The United States, second in rank, averaged with Alaska less than 2,500,000 tons a year. About 1,500,000 persons were closely concerned with fishing in Japan, and about 45 per cent of the world's fishing boats were Japanese.

With an annual per capita consumption of more than 60 pounds, fish was a major part of the Japanese diet. Although not a bulk food, it was always present; with rice and vegetables, aquatic products were essentials of most meals. Fresh fish was eaten raw, boiled, or fried. Larger quantities were preserved—dried, salted, or smoked (Fig. 2). Fish was also used as a flavoring

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[1] Reference is to the fisheries based on Japan proper. If colonial fisheries (Korea, Karafuto, Formosa, the Japanese mandated islands, and the Kwantung Peninsula) are included, the 1931–1938 production ranged from 4,900,000 metric tons to 6,900,000.

➤ MISS ESPENSHADE was research analyst with FEA during the war; from September, 1946, until October, 1947, she served with the Fisheries Division, NRS, GHQ, SCAP (see footnote 2,) and during this period traveled extensively throughout Japan.

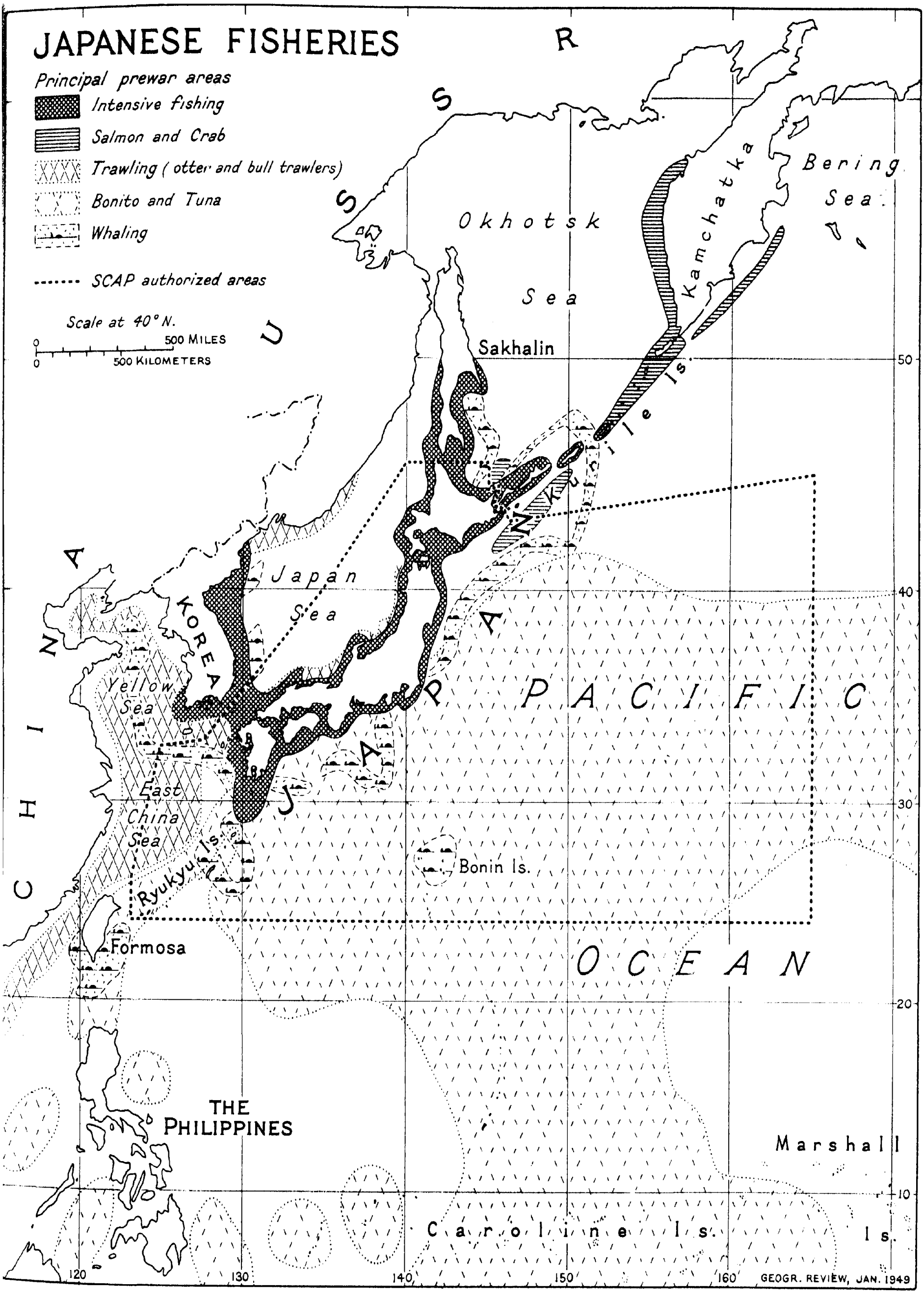


FIG. 1—Prewar Japanese fisheries and the SCAP authorized fishing areas as enlarged June, 1946. It should be noted that "salmon and crab, bonito and tuna, whales, and the species taken by trawling are also taken within the areas of intensive fishing."

The extent of the authorized fishing area is somewhat misleading to those unfamiliar with the production pattern. Much of the area consists of deep waters east of Japan in which operations are confined to pelagic fisheries for a few species, particularly bonito and tuna.

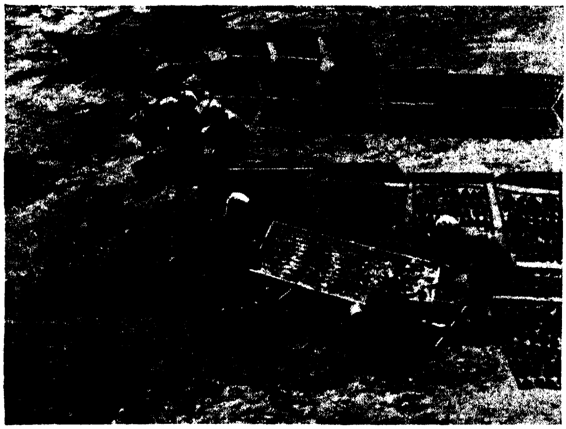
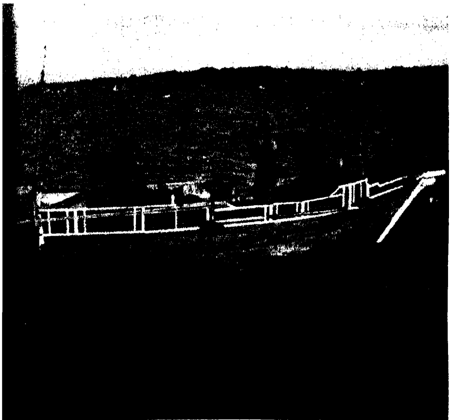


FIG. 2—Drying horse mackerel, *aji*, for the domestic market. (Photograph by Shiga.)

for soups, sauces, and vegetables and was manufactured into pastes and cakes. Seaweed was an important food. The greatest consumption of marine products was in the coastal regions, where most of the population is concentrated, but even in remote inland areas where fresh fish was a luxury some sort of dried, salted, or otherwise preserved fish was eaten almost every day.

Japanese fishing was largely concentrated in the coastal waters of Japan proper and the Kurile Islands, in the Pacific waters east of Japan, along the coasts of Korea, Karafuto, and Kamchatka, and in parts of the Yellow, East China, and South China Seas (Fig. 1). Of less importance were fisheries in tropical waters, Bering Sea, and the Antarctic whaling region. In supplying products for domestic consumption Japan relied chiefly on near-by waters, which are within the present authorized fishing area, but a good part of the production from Korean waters and the trawling grounds of the East China and Yellow Seas, which are largely beyond the present permitted area, was also consumed in Japan proper. Some of the production of southern waters entered Japanese markets in the form of dried bonito sticks (*katsuobushi*). The other prewar areas of production—the rich salmon-crab area of the Okhotsk Sea and the Antarctic whaling grounds—provided principally export products, though they contributed small

FIG. 3—Pulling in a beach seine at Komogawa, Chiba Prefecture; this scene illustrates the intensive use of inshore fisheries. Small catches taken with great expenditure of effort. (Photograph by Shiga.)



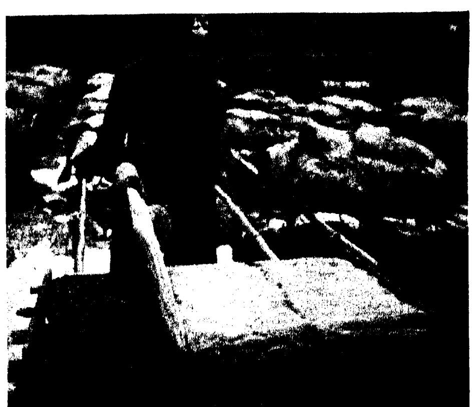


FIG. 4—Small fishing boat used in set-net fishing. About 70 er cent of Japan's prewar fishing was from coastal waters.

FIG. 5—Men, women, and children gathering razor clams 1 a beach of southern Tokyo Bay.

FIG. 6—Unloading herring, Hokkaido. Fish is pitchforked om the boat into baskets. In this process the skin is likely to be ınctured, allowing entry of bacteria.

FIG. 7—Sale of fish at landing, Izu Peninsula. Such landings, largely unrecorded, make production statistics unreliable.

FIG. 8—Seaweed (nori) beds in Tokyo Bay. Seaweed and shellfish are raised in bays and inlets, and fish, especially carp, are cultivated in rice fields and ponds.

FIG. 9—Preparation of agar-agar strips. This product, of relatively high unit value, was formerly exported in quantity.

quantities of food to the domestic market. Part of the catch of southern waters was also exported in the form of canned tuna.

Japan's basic philosophy before the war was that of exploitation and continuous expansion. The expansion phase of the Japanese fisheries is familiar to most Americans, since this included expansion into waters of Alaska, British Columbia, and Mexico and other areas of Latin America. It is not commonly recognized, however, that at the same time Japan was utilizing home waters in an exceedingly intensive manner, far more intensively than Americans and northwest Europeans, who are concerned about overfishing, have used their waters (Figs. 3–7).

Although accurate data and scientific studies are inadequate, it is clear that Japan's coastal and near offshore waters were so intensively fished that reduction of resources was under way by the late 1920's and early 1930's. This reduction of the resources in home waters was largely obscured in Japanese production data because of the expansion to new waters and the relatively high yields from near-by waters maintained by constantly intensified efforts. Several lines of evidence point this way: (1) a leveling-off of the total catch in coastal waters, and of nonpelagic species in offshore waters, in the period 1934–1936 despite increased fishing; (2) reports of fishermen and fish dealers throughout the country that the fish taken and handled locally in recent years were smaller than those of the same species taken and handled 15 or 20 years ago; and (3) specific cases of overfishing of a few species for which scientific studies have been made; for instance, flatfish and sea bream (*tai*) in coastal waters and in bull-trawl (*kisensokobiki*) fisheries in offshore waters. Decline was seen in otter-trawl catches of the East China and Yellow Seas in the period 1929–1939 despite increased fishing; and the waters of the Inland Sea showed depletion of a considerable number of important food species. Although more conclusive studies are desirable, there is sufficient evidence to attest to a serious reduction of resources in the home waters.

Fishing since the Occupation

The Japanese fishing industry has made an excellent recovery since September, 1945. The 1946 and 1947 productions are estimated at about 3,000,000–3,300,000 metric tons annually—a quantity equal to, or slightly above, the prewar production from the same area.[2]

[2] Official Japanese published figures show a much smaller production, but it is known that under prevailing conditions large quantities which are landed are not reported. The estimate given here is that of the Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers (SCAP). Field surveys by NRS personnel and local checks by Military Government officials have indicated the magnitude of unreported landings of fish, some of which enter black-market distribution channels.

This large postwar production has been achieved through the remarkable energy of the Japanese fishermen and their continued encouragement by the Allied command.[3] Rehabilitation of the fishing industry has received considerable attention from the very outset of occupation. A boatbuilding program was started within a few months, and a priority was established for steel and lumber for fishing boats. Increased import of raw cotton was promoted, and allocations from the imports were made for the manufacture of fish nets. Domestic production of hemp was encouraged for use in rope manufacture. Fuel oil imported from the United States was allocated to fishing boats. Increased rice rations were provided for persons engaged in fishing. In June, 1946, with security problems well in hand, the permitted fishing area established in September, 1945, was enlarged. In 1946–1947 and 1947–1948 Antarctic whaling expeditions supervised by SCAP operated to provide additional protein food. It is perhaps this successful recovery of the Japanese fisheries to a high level that has fostered the optimism regarding continued increased production.

Although the present production is large, it falls far short of supplying the increased protein needs of the Japanese people. Without soybeans from Manchuria and other foreign sources of vegetable proteins that provided an essential part of the prewar high-protein foods, and with a continually increasing population, the Japanese are averaging only 55 grams of protein to a person a day, in comparison with 69 grams before the war (nutritionists consider a minimum of about 70 grams necessary for health and 80 grams as desirable).

THE FUTURE

Any plan for long-range increase of fisheries production must take cognizance of the probable limitations of the present resource base. With the problems indicated above in mind, a seven-point program, relating to both long-range and short-term production, is outlined below.

1. *Reorientation and Improvement of Fishery Research*

From a cursory examination of Japanese fishery research it would seem presumptuous to recommend improvement. Japan had for more than a decade before World War II the most extensive system of fishery research in the world. Japanese research, whether measured in number of workers, number of institutions, number of vessels, or expenditures, far exceeded that

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[3] An additional factor may be somewhat revived resources resulting from decreased wartime use. The author largely discounts this, however, because fishing in coastal waters remained relatively high throughout most of the war.

of the United States. But despite the apparent leadership in fisheries research, closer inspection reveals that much of the work being carried out was not of the type which will lead to the solution of the major problems of the future.

Considerable effort was expended on finding new methods to capture more fish—new types of traps to attract fish of all sizes. Use of such gear in coastal waters will only accelerate the reduction of resources already well under way. Much of the prewar research was purely exploratory in distant grounds, which were then exploited; for example, the Japanese located albacore grounds in the mid-Pacific and fished them fairly intensively. Research in the artificial propagation of marine species is probably overemphasized, since it is questionable whether hatcheries can do much to propagate oceanic types of fish.

Japanese scientists have done almost no work on the maintenance of adequate breeding stocks or the conservation of fish until they reach the most productive size. Studies of fish populations for the important commercial fisheries have been neglected. Such studies are essential if Japan is to manage its resources so that in the future there can be a high sustained yield. Other nations also have much to accomplish in this field, but sound beginnings have been made on the Pacific halibut, and some progress on salmon, haddock, and plaice, by scientists of the United States, Canada, and the countries of northwestern Europe.

Reorientation of research toward investigations of the type indicated will be beset with difficulties but is the greatest contribution the occupation can make in the field of fisheries. Japanese scientists have not received recent fishery publications from other parts of the world. They are not accustomed to the free exchange of ideas that Western scientists take for granted. The present organization of governmental research facilities has many undesirable features. And the complicated research problems involved in determining the procedures necessary for attaining maximum sustained yields are unlike the old research problems with which they are familiar.

If research is to be reoriented and improved, guidance will be needed in the initial stages. This means that well-trained Allied research biologists should work closely with Japanese scientists and that Japanese biologists should be allowed to study in Western countries. To date, no provisions have been made to send Allied research scientists to Japan for such purposes, and Japanese are not accepted in Western countries. In spite of many difficulties, if the opportunity is provided, Japan can be reoriented toward future self-sustainment. Japan has a goodly number of well-qualified fishery biolo-

gists and many technicians who, given the right orientation, can contribute the scientific studies necessary to programs of fishery management.

2. *Improvement in the Collection and Compilation of Production Statistics*

Japanese production statistics are notoriously poor as compared with those of more progressive countries. Fishery statistics are no exception. The studies of fish populations suggested above require accurate catch data. Fishery men, trained in the collection of statistics at ports and in organizational procedures for compilation, are needed as guides.

3. *Expanded Educational Program*

Few Japanese are aware of the concept of sustained production of fisheries. The science of fishery management is complicated, but the basic idea of leaving enough fish to form an adequate reproducing stock should not be beyond the comprehension of the public. Press and radio should be employed to teach protection of the fisheries as a basic natural resource for exploitation in the future as well as at present. Japanese elementary schools teach nature study and other phases of the biological sciences, but the wise use of natural resources to provide for the future is not adequately handled. Since it seems likely that scientific investigations will show the need for managed fisheries, the public should be prepared now for later regulation.

4. *Compilation and Reappraisal of Fishery Laws and Regulations*

Japanese laws and regulations affecting fisheries are numerous. A few are nation-wide in application, but most are only prefectural or local. A brief inspection has indicated that those which are protective, as distinct from those pertaining to special privileges, are not impressive. Nor are they adequate, since they were not based on competent scientific investigations and do not provide any definite scheme for management. A compilation should be made of all existing laws and regulations, followed by a thorough study. With the findings of scientific research (provided under 1, above) as a guide, the existing regulations should be reappraised and new ones introduced as needed in a program aimed toward continued high yields. This does not necessarily mean national control of fisheries, for many regulations will properly be local in application, but regulations should fit into regional and national plans for management.

5. *Improvements in Handling and Transporting Fish*

A sizable increase in quantity, and also improvement in quality, can be

achieved through improvements in the handling and transporting of fish. Observation of the methods used in moving the catch from the nets to the boats, in its stowage in the holds, and in the unloading at landing places suggests many needed changes. For example, the puncturing of fish by the indiscriminate use of gaffs and forks, which permits slime, dirt, and bacteria to enter and speed deterioration, is at present preventing the Japanese people from getting the greatest food value from the fish (Fig. 6).

6. *Expansion of Fishing Areas*

The present fishing area, as has been indicated, is producing at a high level, and there are evidences of overfishing in at least some of the fisheries. In order to increase total production by any sizable amount over a period of more than a few years, new areas must be utilized. And if, as is likely, research indicates that a reduced fishing intensity is desirable in coastal waters and near offshore waters to ensure a sustained future yield, Japan will need more than the present area to produce even an amount equal to that produced in 1946 and 1947. There are areas formerly utilized by the Japanese that are not now being fully utilized by other nations. There are also areas in the world with unused fishery resources. It seems economically sound that these areas should be used by the Japanese rather than remain unused while food is being shipped to Japan at the expense of Allied nations.

Expansion of the Japanese fishing area will be regarded with suspicion by other nations. This is fully justified in view of past Japanese methods of intensive use of resources without regard for the future. Any expansion must, therefore, be carefully regulated.[4] But if the Japanese are to become more nearly self-sustaining, expansion of fishing areas is a logical step. Necessary negotiations with other nations should therefore be initiated and vigorously pursued.

7. *Exchange of Fishery Products*

Some of the fishery products from Japanese waters are of relatively high value and could be exported in exchange for larger quantities of lower-priced protein food. Production for export of canned crab, tuna, salmon, and shellfish, frozen tuna and swordfish, agar-agar, and vitamin products should be encouraged (Fig. 9). Although Japan has lost its main export

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[4] Need for enforcement is highlighted by recent incidents in which Japanese fishing vessels were found to be operating beyond the authorized limits. Although advocating enlargement of area as sound policy, the author strongly condemns these activities of a few Japanese fishermen and advocates heavy penalties for all such violations.

producing area, the salmon-crab area of the Okhotsk Sea, it should be permitted to place on foreign markets whatever high-priced products are available. Small quantities are now moving into foreign trade, but the quantities can be increased. Any large increase in exports should, however, be accompanied by arrangements for importing larger quantities of lower-priced fish or other protein food. Cod from Newfoundland and Iceland are possible imports of this type. Vegetable proteins from North China offer another possibility.

This seven-point program for the Japanese fishing industry is focused on the problem of providing as much protein food as possible for the Japanese —in the long-range future as well as in the immediate future. Other problems cannot be discussed here. Among them are the democratization of "fishing rights" and the breakdown of large fishing companies. In improving consumption, attention should be given to distribution, which is also beyond the scope of this discussion.

It is easier to formulate a program than to execute it. But the difficulties of execution do not seem to the author to be insurmountable. And unless the Allied Nations strongly support a farsighted policy leading toward a more stable resource base in fisheries and in other fields of basic production, Japan will become less nearly self-sustaining rather than more so.

RENEWABLE RESOURCES: A WORLD DILEMMA
RECENT PUBLICATIONS ON CONSERVATION

WILMA BELDEN FAIRCHILD

IN October last the press carried an announcement from Moscow of a 15-year plan for reclamation of the steppes: "elimination of drought and soil erosion, reforestation, irrigation, fertilization, crop rotation and adaptation and complete farm mechanization." Derogatory comparison with the conservation work of the United States called forth prompt protest[1] from leading agriculturists. At the same time it was pointed out that "the United States and Russia seem to be up against similar problems" and would find mutual benefit in the exchange of experiences. Similarities in the great grasslands of the two countries were the subject of a classic paper by C. F. Marbut, "Russia and the United States in the World's Wheat Market," published in the *Geographical Review* eighteen years ago. And recently, pertinent comment was made by Fairfield Osborn in "Our Plundered Planet."[2] He concludes an admirably succinct chapter on Russia with the remark: "Both countries are facing the future on approximately equal terms as far as the basic assets for existence are concerned. The future holds the answer as to which nation will be the more successful in using and conserving them!" This view he reiterated in speaking before the *Herald Tribune* forum on "Our Imperiled Resources."[3] So, too, William Vogt, who, in "Road to Survival," finds that "basic to the whole future of the U.S.S.R. and its relationship with the other countries of the world is its ability to cope with agriculture in dry-farming areas."[4]

Loud as the Russian voice is, it does not drown out the conservation chorus from the rest of the world. The cry of conservation has been sounded for many years, but of late a note of urgency, almost of desperation, has become audible, as governments and individuals begin to realize the immediacy of the need for action if the earth's natural resources are to provide freedom from want. In Denver a group of some two hundred scientists from nearly all the countries of the Americas met last September in the first Inter-American Conference on Conservation of Renewable Natural Resources and

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[1] See, for example, *The New York Times*, Oct. 25, 1948, and the response, *ibid.*, Oct. 31.

[2] See footnote 15, below. Reference on p. 141.

[3] The Forum was held October 18–19; it was opened by Bernard Baruch, and many distinguished conservationists spoke. See the *New York Herald Tribune*, Oct. 19–20, 1948.

[4] See footnote 13, below. Reference on p. 231.

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formulated both a program for action and a declaration of trusteeship principles: "No generation can exclusively own the renewable resources by which it lives. We hold the common wealth in trust for posterity, and to lessen or destroy it is to commit treason against the future."[5] In Washington at about the same time the American Association for the Advancement of Science at its centennial meeting held a panel discussion on the world's natural resources; and in Oklahoma a month later the eighth annual meeting of Friends of the Land included sessions on "Let's Outlaw Soil Wasters," "Conservation Lethargy—How to Stop It," and "How Conservation Affects the Citizen."[6] In Texas the *Paris News* got out a special "soil edition" on September 22, 1948, with news, advertising, feature stories, and photographs focused on conservation work in the Red River Valley. In Maryland cooperative effort provided a dramatic demonstration of conservation principles: 500 volunteers working together "face-lifted" the 175-acre farm of Mrs. Nellie Thrasher in eight hours, transforming the straight rows and rectangular fields into a pattern of contour strip cropping, erecting a barn, painting and refurbishing the buildings, constructing diversion ditches, and so on.[7] Similar one-day demonstrations have taken place in Virginia, Georgia, and Colorado.[8]

The British Association for the Advancement of Science, meeting in September last, devoted a session to population and conservation problems and heard Sir John Russell, president-elect for the coming year, recommend that Britain's derelict land, some four million acres of it, be offered free on a 91-year tenure to farmers or groups of people who would undertake to bring it into cultivation.[9] And a recent report of the Wild Life Conservation Special Committee outlines the proposed establishment of national parks, nature reserves, and conservation areas.[10] In Switzerland the Provisional International Union for the Protection of Nature issued in August the first number of its *Pro Natura*, an "organ of information . . . [that] will attempt to draw the attention of those concerned to the problems of Nature Protection which may arise all over the world."[11] From India comes word that a four-

[5] *The New York Times*, Sept. 18, 1948.

[6] *The Land Letter*, August, 1948, p. 16.

[7] "Summary of Maryland Conservation Field Day," University of Maryland, College of Agriculture, Extension Service. (Press release.)

[8] *The Land*, Vol. 7, 1948, p. 224; *The New York Times*, Sept. 19, 1948.

[9] *The New York Times*, Sept. 10, 1948.

[10] Conservation of Nature in England and Wales: Report of the Wild Life Conservation Special Committee (England and Wales), Ministry of Town and Country Planning. v and 139 pp. [*Command Paper*] *Cmd. 7122*. His Majesty's Stationery Office, London, 1947. 4s.

[11] *Pro Natura*, Vol. 1, No. 1, 1948, p. 1. This new periodical is published in Basel; price of single copies, Swiss francs 1.80. The second number appeared in October.

month government-sponsored soil-conservation expedition has penetrated the little-known regions of eastern Nepal for the purpose of studying soil, forest, and water resources in the catchment areas of the Sun Kosi and Arun Rivers.[12]

All this activity on the part of responsible groups makes it somewhat less dismaying to read what has happened to the world's resources and draws attention to what is happening at present or, more important, what can be made to happen.

Conservation in General

Few writers have stated the case for conservation with greater effect and vigor than William Vogt in "Road to Survival."[13] With the unmistakable authority of wide personal knowledge and experience Mr. Vogt interprets the crisis that has arisen from the explosive increase in world population on the one hand and the inexorable decrease in the carrying capacity of the land on the other. The environmental disequilibrium brought about by the disruption of the natural hydrological and biological cycles, in turn a result of man's heedless or ruthless exploitation of the earth's resources, is described in terms of frightening clarity. The reader is jolted into the inescapable conclusion that if our civilization is to survive, certain steps are immediately necessary. The most important of these, Mr. Vogt feels, is a change in our way of thinking from that conditioned by the present economic structure to that conditioned by the potentialities of the total environment. Further, the relentless growth of population must be checked, and at the same time restorative and conservative land-use practices put in train. As a foundation for such action, research is essential; for "without research we shall not know what we are doing. We shall make costly and destructive mistakes." Necessary also is an extensive program of education, making use of every possible device—classes, films, demonstrations, press and radio campaigns, and so on—in order that people may be made sufficiently aware of the world's dilemma to do something about it, and soon. Most of what Mr. Vogt has to say will come as no news to geographers, but some of his observations—such as those regarding the dangers inherent in "elementalistic" or "verbal" thinking—are well worth pondering. In any case, "Road to Survival" is admirably suited to its purpose of arousing the average citizen to a consciousness of his responsibilities, and it is gratifying to note that the book has been widely reviewed and commented upon and that it has rapidly achieved best-

[12] *The* [*Calcutta?*] *Statesman*, July 19, 1948.

[13] William Vogt: Road to Survival. xvi and 335 pp. William Sloane Associates, New York, 1948. $4.00.

seller status. As chief of the Conservation Section of the Pan American Union's Division of Agricultural Cooperation, Mr. Vogt enjoys a uniquely favorable position for making comparative studies of the problem of renewable resources. Some of his monographs for that organization are reviewed by J. Russell Smith in this number of the *Geographical Review*.

Less comprehensively, but no less forcefully, Fairfield Osborn deals with the same problem of too many people, too little sustenance, in a small volume with the apt title of "Our Plundered Planet."[14] The first part is devoted to showing that, despite his mechanical and technical accomplishments, man "has been, is now and will continue to be a part of nature's general scheme"; the second surveys the devastating effects of man's role as "plunderer." In the end Mr. Osborn comes forth with the cogent statement (p. 199):

> The miraculous succession of modern inventions has so profoundly affected our thinking as well as our everyday life that it is difficult for us to conceive that the ingenuity of man will not be able to solve the final riddle—that of gaining a subsistence from the earth. The grand and ultimate illusion would be that man could provide a substitute for the elemental workings of nature.

The remorseless logic of Messrs. Vogt and Osborn is not going unchallenged. Charles E. Kellogg throws down the gage with his article "Who Says the Earth Can't Feed Her People?"[15] It is Dr. Kellogg's belief that enough food could be produced to feed twice the world's present population, through technological advances in lands already being cultivated and through the addition—in theory at least—of some 1⅓ billion acres of podzol and tropical soils to the cropland area. However, he frankly admits the difficulties involved, physical, political, and economic. Much the same conclusion, resting on a similar base, was reached by Robert M. Salter, chief of the Department of Agriculture's Bureau of Plant Industry, Soils, and Agricultural Engineering.[16]

A third book that deals with conservation generally is Ehrenfried Pfeiffer's "The Earth's Face."[17] Dr. Pfeiffer, a Swiss agrobiologist resident in the United States, treats land use in terms of landscape types—plains, mountains, forests, urban centers, and so on. For each he discusses the problems involved in the maintenance of its "health" and evaluates its economic and spiritual

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[14] Fairfield Osborn: Our Plundered Planet. xiv and 217 pp. Little, Brown & Co., Boston, 1948. $2.50.

[15] *Successful Farming*, Vol. 46, No. 11, 1948, pp. 31 and 106–109.

[16] Robert M. Salter: World Soil and Fertilizer Resources in Relation to Food Needs, *Science*, Vol. 105, 1947, pp. 533–538.

[17] Ehrenfried Pfeiffer: The Earth's Face: Landscape and Its Relation to the Health of the Soil. 138 pp. Faber & Faber, London, 1947. 12s. 6d.

contributions to man's well-being. His insistence on the spiritual benefits man may derive from an environment in balance gives his book unusual interest; for this is an aspect too often taken for granted or passed over lightly by the scientist and the technician.

THE PROBLEM IN JAPAN

The world-wide general problems set forth in the three books just considered are brought into sharp focus in a stimulating article by Lieutenant Colonel Hubert G. Schenck on "Natural Resources Problems in Japan."[18] Colonel Schenck, who is chief of the Natural Resources Section, General Headquarters, SCAP, in Tokyo, gives a concise, informative, and most interesting summary of the activities and planning undertaken by the Allied Powers toward the goal of effective resource use, as regards both immediate needs and future good.

The first necessity, obviously, was to provide as much food, fuel, and building materials as possible within as short a time as possible.

> Thus, short-range problems of increasing food production by adequate production and distribution of fertilizer, by reclamation of unused arable land for agricultural purposes and by supervision of crop collections were the first agricultural problems. The urgent needs of the fisheries were primarily vessels, nets, cordage, and fuel. So far as the forests and the mineral resources were concerned, the primary problem was to increase fuel production and to obtain as much lumber for rebuilding as was consistent with future productivity of the forests. . . .
>
> Some of the resources are renewable if properly managed. Accordingly, the sequels to these immediate problems were the problems of sustained yields. Consideration has been given to agricultural research and dissemination of its results, to research on fish population management, to reforestation and erosion control, and to improvements in technology of use of wood products. Finally, the Japanese have been encouraged to begin planning on a national scale for the development and use of their natural resources.

A great deal has been accomplished within this general framework. In the agricultural field alone, reclamation and improvement projects have already added considerable arable land to the total cultivated acreage, a reconnaissance soil survey—"the first to employ modern methods of classifying and mapping Japanese soils"—is nearly complete, research and extension activities have been coordinated, and an adequate crop-reporting system has been established. As a barometer of progress, it may be noted that in 1947 agricultural production reached 93 per cent of the 1931–1940 figure, as compared with 76 per cent in 1945.

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[18] *Science*, Vol. 108, 1948, pp. 367–372.

Similar fundamental studies and activities are being carried on in the fishing and forest industries, always with the ultimate objective of a sustained yield. Production in the fisheries has reached seven million pounds, "which is about as much as the present fishing area can support," and the problem now is less one of exploitation than of proper management. The situation as regards forestry is considerably more complicated. All the readily accessible forest areas have been badly overcut, and a reforestation program has therefore been established, under which "780,000 acres have been reforested since the beginning of the occupation." The excessive demand for lumber has raised serious difficulties for the foresters, but a partial solution has been found in the opening up of hitherto inaccessible forest areas through the construction of new roads; some 495,000 acres of forest land have been made available in this way. In the mining industry, survey and exploration programs have been initiated, and new mining and milling methods introduced.

The entire program of resource use would seem from Colonel Schenck's report to be unusually effective, and thus of vital interest to conservationists and geographers. This is particularly true when it is realized, as the author points out, that

> in Japan, the outcome of the Pacific war has given the Allied Powers the opportunity to direct all of their wisdom and good will toward mitigating the tragedies of its causes. Seen from this perspective, the work of the occupational forces has an historical significance of the first magnitude.

CONSERVATION OF SOILS

Soil studies continue to take first place, quantitatively, among recent publications in the field of conservation. One of the best is "Soil Conservation: An International Study," issued by the Food and Agriculture Organization of the United Nations.[19] This is a symposium volume, numbering among its contributors such well-known experts as J. Lossing Buck, Charles E. Kellogg, and Robert L. Pendleton. Primary emphasis is on the physical bases of erosion and land-use problems, but economic and social factors such as taxation, markets, tenure, legislation, and education are treated in some detail. Considerable attention is also paid to forest lands and soils, on the premise that "good and permanent agriculture depends on good and permanent forestry."

The publisher of Raymond Furon's "L'Érosion du sol" makes for the

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[19] "Soil Conservation: An International Study." viii and 189 pp. *FAO Agric. Studies No. 4.* Food and Agriculture Organization of the United Nations, Washington (sales agent for the United States and Latin America: Columbia University Press, International Documents Service, New York City), 1948. \$2.00. Reference on p. 2.

book the somewhat startling claim that it is "le premier dans le monde entier qui expose complètement le problème du sol."[20] Whether or not this is true, the book is certainly comprehensive in scope. Part I deals with the soil itself, its nature, origin, evolution, and "death"; Part II surveys erosion throughout the world; and Part III treats possible means of averting "la catastrophe qui menace le monde." This part includes an effective discussion of the difficulties involved in a program of conservation education, especially among farmers in the more primitive parts of the world. Furon points out that, to overcome not only incomprehension and ignorance but centuries-old tradition as well, "il faut entreprendre une propagande adroite, et cette propagande ne peut être adroite que si elle tient un compte exact des réactions psychologiques de ceux à qui elle est destinée."

In "Reconstruction by Way of the Soil" G. T. Wrench develops the thesis that health, both of individuals and of society, is dependent on what he terms the "rule of return"—the principle that all organic matter must in one form or another be returned to the soil from which it came.[21] Where this basic rule is ignored and more is taken from the earth than is returned to it—the author is eloquent on the evils of the profit motive in agriculture—the products of the soil are deficient in nutritive value, quality, and quantity. But where it is followed, as among the Hunzas of northern India, a high standard of health and environmental harmony is achieved. In making his point, Dr. Wrench provides what amounts to an outline history of agriculture from ancient times to the present, demonstrating the effects of soil deterioration on civilization.

A successfully graphic presentation of soil-conservation problems is to be found in "The Land Renewed" by William R. Van Dersal and Edward H. Graham.[22] A series of excellent photographs showing the destructive effects of erosion and the restorative effects of conservation are accompanied by brief but telling text-captions. The simplicity of the treatment and the choice and quality of the illustrations should recommend this book for use in the educational programs envisioned by many conservationists. The same

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[20] Raymond Furon: L'Érosion du sol: Origine et évolution des sols; influence de l'homme sur la dégradation et la disparition des terres arables; l'érosion du sol dans les cinq parties du monde; l'organisation scientifique de la protection du sol. 218 pp. (Bibliothèque Scientifique.) Payot, Paris, 1947. 360 fr. References on publisher's insert and on pp. 209–210. M. Furon has published a condensed version of some of the same material in "Les problèmes de l'érosion du sol," *Rev. Internatle. de Botanique Appliquée et d'Agric. Tropicale*, Vol. 28, 1948, pp. 281–296.

[21] G. T. Wrench: Reconstruction by Way of the Soil. 262 pp. Faber & Faber, London, 1946. 12s 6d.

[22] William R. Van Dersal and Edward H. Graham: The Land Renewed: The Story of Soil Conservation. 109 pp. Oxford University Press, New York, 1946. $2.00.

remarks may be applied to W. X. Hull's "The Soil Conservation Way."[23] In this publication, however, the photographs are both larger (8 by 10 inches) and more numerous, and the text-captions are in Spanish, French, and Portuguese as well as in English. Reference should also be made to J. R. Whitaker's "The Life and Death of the Land,"[24] a collection of essays that

> fall easily into three groups. The first deals with the whole problem of the "life and death of the land," a challenge to every one of us. The second group is concerned more directly with the teaching of conservation, particularly in geography classes. The third, somewhat more technical in style, is concerned with the history and theory of conservation.

And in this general category we may likewise include a book already familiar to many teachers and workers in the conservation field, H. H. Bennett's "Elements of Soil Conservation."[25]

Regional studies in soil conservation include several recent books very different in approach and locale yet each in its own way a useful contribution to the literature. R. Maclagan Gorrie's "Soil and Water Conservation in the Punjab" is a manual written primarily for the use of officials concerned with land management in that region.[26] It "attempts to lay down the details of practical field work in the various phases of afforestation of catchments, reclamation of torrent beds and waste land, and the control of run-off from cultivation." The text is simply and clearly written in the form of an expanded outline, and though it is technical, the techniques are reduced to elementary terms and illustrated with rough but effective diagrams.

When we turn to the continent that has suffered perhaps more than any other from the pernicious effects of erosion, we have "Afrique, terre qui meurt" by Jean-Paul Harroy, a monograph impressive both in size and in scope.[27] Its central theme is the destructive influence of European colonization on the land and, correlatively, the native life of Africa; the interrelationships between the physical and the human factors involved are pointed up with extraordinary skill. For the geographer, this book provides a wealth of factual and interpretative material, and it contains an extensive bibliography. M.

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[23] William X. Hull: The Soil Conservation Way. [184 pp.] U. S. Dept. of Agriculture, Soil Conservation Service, 1946.

[24] Joe Russell Whitaker: The Life and Death of the Land. 118 pp. Peabody Press, Nashville, Tenn., 1946. $1.30. Reference on p. 3.

[25] Hugh Hammond Bennett: Elements of Soil Conservation. x and 406 pp. McGraw-Hill Book Co., New York and London, 1947. $3.20.

[26] R. Maclagan Gorrie: Soil and Water Conservation in the Punjab. [v,] viii, and 290 pp. 1946. Rs. 5-0-0 or 7s. 6d. Reference on p. [iv].

[27] Jean-Paul Harroy: Afrique, terre qui meurt: La dégradation des sols africains sous l'influence de la colonisation. x and 557 pp. Marcel Hayez, Brussels, 1944. 250 Belgian francs.

Harroy, who is both secretary of the Comité de Direction de l'Institut des Parcs Nationaux du Congo Belge and director of the Fondation pour favoriser l'étude scientifique des Parcs Nationaux du Congo Belge, has also published "Protégeons la nature: Elle nous le rendra," comprising the texts of four lectures delivered at the Université Coloniale de Belgique.[28] These explain the concepts underlying the establishment of the national parks of the Belgian Congo and discuss the policies that guide their direction.

To the south, problems of soil destruction and erosion control in the western lowland of the Cape Province form the subject of "Swartland and Sandveld" by W. J. Talbot.[29] Introductory chapters describe the geomorphology, climate, and natural vegetation of the region and explain concisely the processes of soil genesis and degeneration. The main part of the book, however, is devoted to a survey of the distribution of soil erosion in the western lowland and the conditions under which it has taken place. An accompanying map (in two sheets) on the scale of approximately 1:125,000, compiled chiefly from air photography, shows gullies, wind-eroded arable land, and marshland. In the final section of the report the author presents a program for erosion control based principally on planned land utilization, reorganized farm economy, application of conservation and reclamation measures, and "propagation of conservational methods of husbandry" (i.e. education). Professor Talbot feels, and rightly, that

> it is not sufficiently widely realised that *soil erosion is the brand-mark of bad farming*, and that land which is used only for purposes to which it is naturally suited and is properly managed under a sound system of field husbandry does not normally suffer appreciable losses through soil erosion.

Maps, diagrams, and well-selected photographs add value and interest to the book.

In a regional study of a quite different kind—one might almost call it a case history—Vance Johnson tells the story of the Dust Bowl region of the southern Great Plains from the period of early settlement through the stockmen's era, the boom of speculative wheat farming at the time of the First World War, the disaster of the dust years, and, finally, the beginnings of conservation methods under the aegis of the Soil Conservation Service.[30]

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[28] *Idem:* Protégeons la nature: Elle nous le rendra. 97 pp. Institut des Parcs Nationaux du Congo Belge, Brussels, 1946.

[29] W. J. Talbot: Swartland and Sandveld: A Survey of Land Utilization and Soil Erosion in the Western Lowland of the Cape Province. xii and 79 pp. Oxford University Press, Cape Town, 1947 $3.50 (Oxford University Press, New York). References on pp. 76 and 77.

[30] Vance Johnson: Heaven's Tableland: The Dust Bowl Story. 288 pp. Farrar, Straus & Co., New York, 1947. $3.00.

The book was written for popular consumption, and the easy, somewhat journalistic style makes diverting reading, even though the sequence of events may be familiar.

Conservation of Forests

The basic role of forests in the conservation of both water and soil is made clear in a number of publications dealing with the world's badly depleted forest resources and their use. For an over-all survey of the situation, "Forestry and Forest Products" published by the Food and Agriculture Organization of the United Nations is recommended.[31] The report consists of three parts: (1) a discussion of the forestry situation in the major regions of the world; (2) world balance sheets for the most important forest products; and (3) general conclusions and recommendations for national and international action. In his excellent preface Sir John Boyd Orr points out:

> A comprehensive world forest policy must be directed toward a dual goal: First, sufficient forest areas to ensure the benefit of their protective influences, and second, a permanent and abundant supply of forest products.

He states the question of forest conservation in its broader terms:

> The forests must be managed as perpetually renewable crops. Waste must be reduced. Legislation must be invoked and the forces of education mobilized to protect the forests from fire and destructive exploitation. Afforestation must be undertaken on a scale never before dreamed of, to create forest values in areas now barren and restore millions of hectares lost to agriculture. The two thousand million hectares of forests that still remain untouched must be converted into economic and social assets. The number of trained foresters must be increased many times.

This summary statement keynotes the recommendations offered in the final section of the report, particularly with respect to long-range planning.

Similarly based on Sir John Orr's statement is the program advocated by the Empire Forestry Association in "The Forest, Forestry and Man,"[32] but it urges that planning be prefaced by "a joint ecological survey by ecologists, soil scientists, agriculturists and foresters, of all land, whether forest or agricultural." This insistence on the total environment, rather than on any single feature of it, is repeated throughout the report. For example:

> A forest, therefore, includes not only trees but also a great variety of organisms with many and varied relations to the trees and to each other. . . . Generally speaking, a forester's power

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[31] "Forestry and Forest Products: World Situation 1937–1946." 93 pp. Food and Agriculture Organization of the United Nations, Stockholm, 1946. 75 cents. References on p. 7.

[32] "The Forest, Forestry and Man." 68 pp. Empire Forestry Association, London, 1947. 4s. References on pp. 61–62 and 32 respectively.

over the forest will depend on his knowledge of the processes taking place in it and of their manifestations.

The ecological approach is also demonstrated in "El bosque y la conservación del suelo" by Helmuth Wagner and Hans Lenz,[33] of which William Vogt has said: "[It] is one of the finest presentations of forest-land-human relationships I have ever encountered in any language." The book has a twofold virtue: first, in the soundness of the material; and second, in the freshness and originality of the presentation. The story is told essentially by means of brisk and altogether charming little sketches, amplified by a simple, explanatory text, so that problems of deforestation, overgrazing, burning, erosion, and so on can be painlessly, even entertainingly, absorbed by the most uninformed reader.

At the other end of the scale is a technical treatise by S. A. Wilde on "Forest Soils and Forest Growth."[34] This is a kind of textbook, originating from lectures delivered to a class in soils at the University of Wisconsin, and covering in detail such matters as the genesis of forest soils, their physical, chemical, and biological properties, and the basic principles of silviculture. Unquestionably a valuable work in its special field, Dr. Wilde's book has the added value of a carefully prepared subject index and an exceptionally comprehensive bibliography.

Various special phases of forestry formed the subjects of papers read at a symposium on "Forestry and the Public Welfare" of the American Philosophical Society,[35] which has already been noted in these pages. Several of the discussions bear particularly on conservation, notably Raphael Zon's "Forests in Relation to Soil and Water," W. C. Lowdermilk's "World-Wide Needs of Woods as a Land Conservation Crop," and Wilson Compton's "Forest Conservation: A Task in Engineering and in Public and Private Cooperation."

Other Aspects of Conservation

Though soils and forests are acknowledged to rank among the fundamental natural resources, there are others that likewise deserve a full measure of consideration. One of these is wildlife. The *Transactions* of the Thirteenth

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[33] Helmuth O. Wagner and Hans Lenz: El bosque y la conservación del suelo: Su importancia cultural y económica. 169 pp. Editorial Cultura, México, D. F., 1948. $4.00 (American). [Orders should be addressed to H. O. Wagner, Apart. 7901, Sul. 3, México, D. F.]

[34] S. A. Wilde: Forest Soils and Forest Growth. xxii and 241 pp. (A New Series of Plant Science Books, Vol. 18.) Chronica Botanica Co., Waltham, Mass. (Stechert-Hafner, Inc., agent in New York City), 1946. $5.00.

[35] "Symposium on Forestry and the Public Welfare." iii and 399–488 pp. *Proc. Amer. Philos. Soc.*, Vol. 89, No. 2, 1945. $1.00. (See also the *Geogr. Rev.*, Vol. 35, 1945, p. 669.)

North American Wildlife Conference, held in St. Louis in March, 1948,[36] includes papers both technical and conservational in interest. Among the latter are some unusually provocative titles; for example, "A Bird in the Bush is Worth Two in the Hand," "Bow 'n' Arrow Hunting—Good Conservation," "Under the Wildlife 'Blanket of Ignorance'." The program as a whole was directed toward the general theme "Wildlife Wealth, If We Want It." That we should indeed want it is made clear by Edward H. Graham in his well-written book "The Land and Wildlife."[37]

> We want wildlife in America because it affords recreation to millions of people, because it provides a very substantial economic return to a great many others, and above all, perhaps, because it is a valuable heritage and an expression of a national house in good order. Wildlife flourishes where man has succeeded in adapting himself to the land on which he lives and where he has attained a degree of bountiful living.

Dr. Graham's method of achieving this desired end is not so much through the establishment of sanctuaries and reserves as through the utilization of the "odd spots" on every farm that are well suited to the growth of wildlife. Such odd spots, unsuitable for crops, pasture, or woodland, are gullies, rocky outcrops, spoil banks, field borders, and marshy areas. These can usually be converted into favorable habitats for wildlife with only a moderate expenditure of time and effort and thus become a valuable part of an integrated land-use program on any farm. It is the author's estimate that "there are no less than 33 million acres of land on American farms and ranches" best suited to wildlife production.

Another publication of interest to the enterprising farmer as well as to the conservationist is "Food at the Grass Roots," a pamphlet issued by the Tennessee Valley Authority and concerned with the results obtained from the application of mineral fertilizers, chiefly phosphates, to the soils of a large number of test demonstration farms.[38] The theory propounded is that an effective program linking agriculture, husbandry, and human nutrition must start not only with the soil, but

> especially with the 5 percent of exhaustible soil minerals with which we mobilize the remaining 95 percent of the elements that go into the making of plant, animal, and human life.

The correctness of the theory would seem to be proved by the truly remarkable results achieved on the demonstration farms—a surprising improvement

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[36] Edited by Ethel M. Quee. x and 650 pp. Wildlife Management Institute, Washington, D. C., 1948. $1.50.

[37] Edward H. Graham: The Land and Wildlife. xiii and 232 pp. Oxford University Press, New York, 1947. $4.00. References on pp. vii and 51.

[38] "Food at the Grass Roots: The Nation's Stake in Soil Minerals." vii and 100 pp. Department of Agricultural Relations, Tennessee Valley Authority, Knoxville, Tenn., 1947. References on pp. 33 and 37.

in crop yields, increased fertility of animals, markedly better health among the farm families, and, most important, a notable decrease in erosion through the provision of superior cover crops. To illustrate this last, a test is cited of 100 farms in North Carolina that over a period of five years showed an average reduction in soil loss of some 70 per cent. According to TVA:

> The United States has large reserves of phosphate. Even if the present rate of consumption were multiplied by two or three, . . . we have enough to last a very long time—although certainly not indefinitely.

The evident conclusion is that these reserves must be wisely controlled and used, and a program is offered to that end.

To turn from the practical to the philosophical, mention must be made of an unusual and refreshing book that, though dealing with no specific resource, yet conveys most eloquently the essence of the ecologist's point of view. "Land and Landscape" by Brenda Colvin[39] ranges over a variety of topics, from formal gardens to wilderness scenery, from urban planning to cultivation patterns, but the fundamental idea developed throughout is that "human use of the land alters but should not destroy beauty: the use of the land and beauty of the landscape, both necessary conditions of human progress, are inseparable to that end," and, further, that "the inborn appreciation of natural beauty is a subconscious recognition of 'balance' in our surroundings."

This is altogether an eminently quotable book, with a quality difficult to project in any other way than by quotation. However, restraint in this regard is obviously indicated, and we will therefore confine ourselves to one final passage that puts a fitting period to a discussion on conservation:

> The biological balance between soil, plant and animal—an essential condition of life—produces in the landscape visual relationships of form, colour and texture which evoke a profound response in human consciousness. That response is a progressive factor, a criterion which we ought to value and understand and develop to the fullest extent.

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[39] Brenda Colvin: Land and Landscape. xii and 266 pp. John Murray, London, 1948. 21s. References on pp. 256–258.

POSTSCRIPT. The Society has just received numbers of the *Journal of Soil and Water Conservation* from January, 1946 (Vol. 1, No. 1), to date. The *Journal* is published quarterly by the Soil Conservation Society of America (address the Secretary, Box 1409, Spartanburg, S. C.). Its interests are wide in range. The July, 1948, number, for instance, includes articles on soil fertility in Britain, maintenance of productivity in irrigated lands, use of vegetation in military construction, and Aldo Leopold's "The Ecological Conscience," reprinted as a memorial to that distinguished conservationist.

BOUNDARIES AND INTERNAL PROBLEMS OF IDAHO*

BENJAMIN E. THOMAS

BOUNDARIES may make difficulties between states as well as between nations, and even within states boundary dissensions may be a source of trouble. In Idaho problems of intrastate sectionalism, transportation, and higher education are closely associated with the peculiar outline of the state.

EVOLUTION OF THE BOUNDARIES OF IDAHO

A hundred years ago Idaho was merely a part of Oregon Territory, which lay between Canada and California and extended from the Rocky Mountains to the Pacific Ocean (Fig. 1*a*). In 1853 Washington Territory was separated from Oregon Territory by a boundary that followed the Columbia River from the Pacific coast to the intersection of the river with the 46th parallel and then ran eastward along this parallel to the main range of the Rocky Mountains[1] (Fig. 1*b*).

Settlement was more rapid in the Willamette Valley and near-by parts of Oregon than in Washington, and in 1859 Oregon was admitted as a state,[2] with the present eastern boundary, which follows the Snake River and a north-south line. Oregon's boundaries were now complete. The remaining part of Oregon Territory (east of the Snake River in what is now southern Idaho) had no agricultural settlements or mines at that time and was hundreds of miles from the coast. This Indian-infested remnant of mountains and deserts was attached to Washington Territory (Fig. 1*c*). The elongate, irregular Territory of Washington now consisted essentially of the undeveloped remainder of old Oregon.

The discovery of gold in what is now northern Idaho in 1860 and in southern Idaho in 1862 caused an influx of population into these areas. The capital of Washington Territory, Olympia, was separated from the new mining areas by hundreds of miles of deserts and mountains. The need for a seat of government much closer to the mines was generally recognized; also, agricultural western Washington desired a new territorial division that

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*Revision of a paper presented before the Association of American Geographers, Charlottesville, Va., December 31, 1947.

[1] "An Act to Establish the Territorial Government of Washington," March 2, 1853, *in* Statutes at Large and Treaties of the United States (Little, Brown & Co. edit.), Vol. 10, 1866, pp. 172–179.

[2] "An Act for the Admission of Oregon into the Union," February 14, 1859, *in* Statutes at Large (*op. cit.*), Vol. 11, 1859, pp. 383–384.

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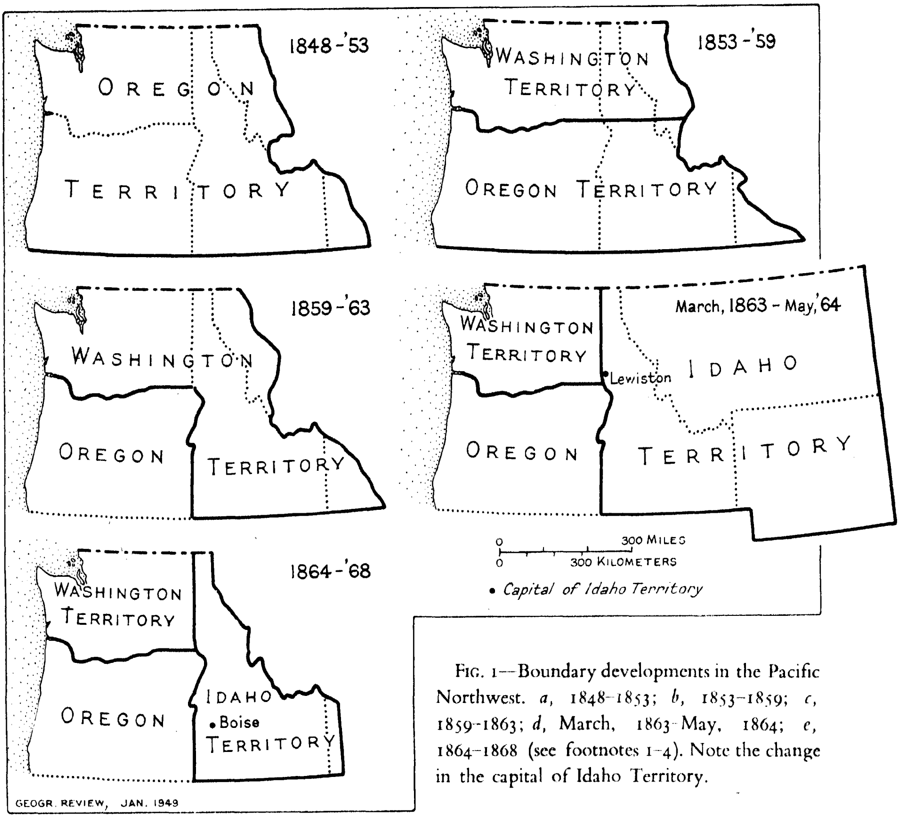

FIG. 1—Boundary developments in the Pacific Northwest. *a*, 1848–1853; *b*, 1853–1859; *c*, 1859–1863; *d*, March, 1863–May, 1864; *e*, 1864–1868 (see footnotes 1–4). Note the change in the capital of Idaho Territory.

would enable it to gain early statehood. After considerable debate, Washington was reduced to its present size in 1863 by a boundary line running northward from the northeast corner of Oregon.[3] The eastern boundaries of Washington and Oregon now formed a fixed border for their new neighbor, Idaho Territory, which thus inherited the remainder of the old Oregon Country plus undeveloped land on the east (Fig. 1*d*). The territorial capital was located at Lewiston, in the north, which was accessible from the Pacific coast and was also near the new placer mines.

The northern, southern, and western boundaries of Idaho were now complete. In 1864 Congress organized Montana Territory, at the request of its inhabitants, with a western boundary following, in the main, the crest of the Bitterroot Mountains. This range separated the mining population of Montana from the mines of northern Idaho, and from the capital, Lewiston. Most of the area today included in Wyoming was attached to Dakota Terri-

[3] *Congressional Globe*, 37th Congr., 3rd Sess., 1863, pp. 94, 914, and 1542.

tory,[4] and thus part of the eastern boundary of Idaho was carved out (Fig. 1*e*).

The placer mines of northern Idaho declined while new ones were being discovered in the south. The south soon had a majority of the population and of the votes in the Idaho Territorial Legislature, and in 1864 the capital was moved from Lewiston in the north to Boise, in the south.[5]

In 1868 the Territory of Wyoming was organized,[6] and a strip of land was taken from Idaho and joined to it "in order to attain symmetry in the geographical boundaries in the new [Wyoming] Territory."[7]

This completed the evolution of Idaho's outline. The changes had occurred mostly at the request of other states and territories. Like a remnant of cloth from which the desired pieces have been cut, Idaho's shape possesses neither logic nor beauty—it has been called a "geographic monstrosity."

Geography and Intrastate Sectionalism

Rectangular southern Idaho and the northern extension, or panhandle, are separated by a rugged mass of almost uninhabited mountains. North of this barrier there are three east-west transcontinental railroads and two highways: the Great Northern Railway, the Northern Pacific Railway, the Chicago, Milwaukee, St. Paul and Pacific Railroad, U. S. Highway 10, and U. S. Highway Alternate 10. South of the mountains there are another east-west railroad and highway, the Oregon Short Line (Union Pacific) Railroad and U. S. Highway 30.

But no lines within the state connect the northern and southern railroads; until recently there was not even a usable north-south highway. To go by rail from northern Idaho to the state capital, one must go southwest through Washington and Oregon and then back into Idaho or else east into Montana, south into Idaho, and then west to the capital.

The strong geographic contrasts between northern and southern Idaho are well defined in the precipitation map (Fig. 2). Most of the humid north is forested hilly or mountainous country with many lakes. Idaho's large

[4] "An Act to Provide a Temporary Government for the Territory of Montana," May 26, 1864, *in* Statutes at Large (*op. cit.*), Vol. 13, 1866, pp. 85–92.

[5] This started a series of bitter disputes between northern and southern Idaho. Cf. E. B. Chaffee: The Political Clash between North and South Idaho over the Capital, *Pacific Northwest Quart.*, Vol. 29, 1938, pp. 255–267; and C. S. Kingston: The North Idaho Annexation Issue, *Washington Hist. Quart.*, Vol. 21, 1930, pp. 133–137, 204–217, and 281–293.

[6] "An Act to Provide a Temporary Government for the Territory of Wyoming," July 25, 1868, *in* Statutes at Large (*op. cit.*), Vol. 15, 1869, pp. 178–183.

[7] *Congressional Globe*, 40th Congr., 2nd Sess., 1868, p. 2793.

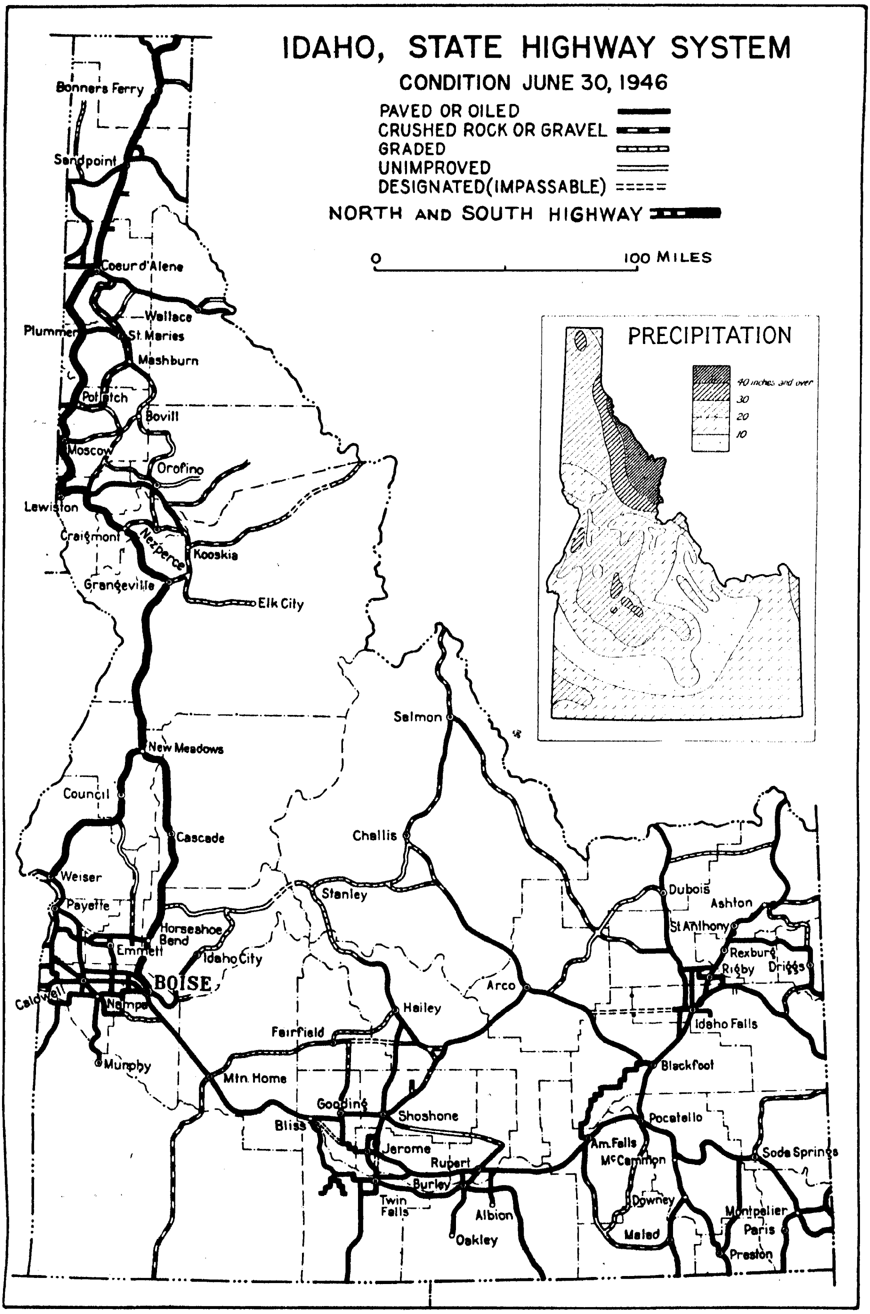

FIG. 2—Roads and rainfall of Idaho. Roads are reproduced from an Idaho Bureau of Highways map, with strengthening of the North-South Highway.

The inset rainfall map is a simplified reduction of Figure 31 in H. A. Vogel and N. W. Johnson: Types of Farming in Idaho, Part I, Agricultural Resources and Factors Affecting Their Use, *Univ. of Idaho Agric. Exper. Station Bull.* No. 207, 1934. The report includes an interesting series of maps.

production of lead and silver comes from this area, also timber, and wheat from the Palouse Hills section.

Arid southern Idaho is mostly a sagebrush plain where sheepherding and irrigation farming are typical activities. The well-known Idaho potato comes from irrigated lands in the south where water is obtained from the Snake River and its tributaries. Since the development of large-scale irrigation the south has had most of the population of the state.

The physical and economic differences between north and south are accentuated by the central mountain barrier, the poor north-south communication, and the location of the regional capitals.

To the people of the Idaho Panhandle, arid southern Idaho is a world apart. They share interests with near-by parts of Washington and Montana, and their economic and cultural metropolis is Spokane, Wash., capital of the "Inland Empire."[8]

In southern Idaho the people have ready access to parts of Utah, Oregon, and Wyoming. Economic interests center on irrigation farming and grazing rather than on lumbering and mining. The regional center for the western part is Boise, the capital and largest city of the state. But southeastern Idaho, with a large percentage of Mormons, has close economic, social, and religious contacts with Salt Lake City, Utah.[9]

State boundaries link north and south together and force them into contact—and often conflict—on such matters as state taxes, institutions, and highways,[10] but intrastate sectionalism is strong. When a resident of Idaho is asked where he is from, instead of saying "Idaho," he commonly answers, "Northern Idaho" or "Southern Idaho."

Proposed Boundary Changes

Northern Idaho has tried many times to secede from the south. Between 1885 and 1887 the Washington and Idaho Territorial Legislatures requested Congress to annex northern Idaho to Washington (Fig. 3a). A bill providing for the boundary change[11] was introduced in the House of Representatives. The Committee on Territories reported the bill out with a strong argument on geographical grounds for annexation of the Panhandle to Washington:

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[8] G. W. Fuller: The Inland Empire of the Pacific Northwest, 3 vols., Spokane, 1938; R. R. Martin: The Inland Empire of the Pacific Northwest: A Regional Study (Diss., Ph.D., University of Washington, 1935).

[9] M. D. Beal: A History of Southeastern Idaho, Caldwell, Idaho, 1942; and C. D. Harris: Salt Lake City, A Regional Capital (Diss., Ph.D., University of Chicago, 1940), Chicago, 1940.

[10] Political disputes are covered in more detail by L. H. Chamberlain: Idaho: State of Sectional Schisms, *in* Rocky Mountain Politics, edited by T. C. Donnelly, Albuquerque, 1940, pp. 150–188.

[11] House Bill 2889, *Congressional Record*, 49th Congr., 1st Sess., 1886, p. 1706.

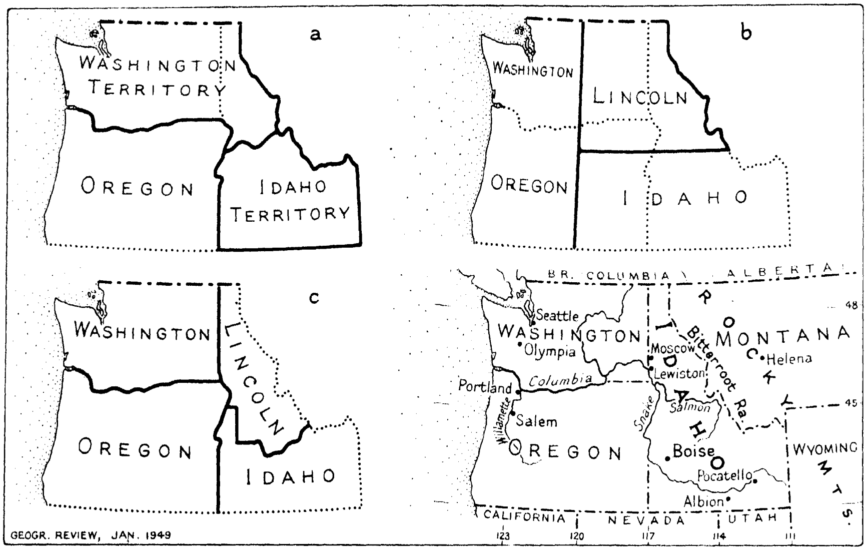

FIG. 3—Suggested divisions of Idaho, 1886–1917: *a*, House Bill 2889, 49th Congress, a boundary proposal that almost succeeded; *b*, Proposed state of Lincoln, 1907; *c*, Proposed state of Lincoln, 1917.

It appears that that portion of Idaho, the annexation of which to Washington Territory is contemplated, cast a vote of 2,788 on November 4, 1884, indicating, at a ratio of population to vote of 4.7, a population of 13,103. These people are almost wholly isolated from the southern portion of the territory by the Salmon River range of mountains, which are exceedingly rugged and precipitous in their character. The construction of a wagon road across these mountains from north to south has thus far been regarded as wholly impracticable, so that at this time the sole direct means of communication between the two sections consist of a primitive Indian trail. During six months of the year this trail affords facilities alone to those who are expert in the use of snowshoes. Under the most favorable conditions, pack-animals alone furnish any means of direct communication.

Because of the natural barriers indicated, a journey from any portion of northern Idaho to Boise City, the capital, is a very tedious and expensive affair. The distance across the mountains ranges from 200 to 400 miles, while the distance necessary to be traveled ranges from 400 to 600 miles, the route being a very circuitous one, through the Territory of Washington and the State of Oregon. For these reasons there are practically no commercial relations between these sections of Idaho, while on the other hand, the northern section is so situated with reference to Washington Territory as to make their interests—social, political, and commercial—identical.[12]

The bill passed both houses of Congress but received a pocket veto from the President. One objection was that southern Idaho would be too small in population for early admission as a state. Also, Montana wanted the Pan-

[12] "Report No. 216," Reports of Committees of the House of Representatives for the First Session of the Forty-ninth Congress, 1885–86, Washington, 1886.

handle, and some of the northern Idaho miners preferred inclusion in the mining Territory of Montana to union with agricultural Washington.[13]

In 1907 certain factions of eastern Washington, supported by elements from northern Idaho, proposed to create the state of Lincoln. The new state, with Spokane as its economic and political center, was to constitute an "Inland Empire" of eastern Washington, northern Idaho, and northeastern Oregon, as shown in Figure 3b. Southern Idaho was to be enlarged by annexation of a part of eastern Oregon.[14]

These changes were designed to free Spokane from the "domination" of Olympia and Seattle, to make a political unit of the Inland Empire, and to end the north-south struggle in Idaho. The proposal was received with mixed feelings of amusement and irritation in western Washington and Oregon, and the movement did not pass beyond the discussion and agitation stage.

Early in 1917 antagonism between northern and southern Idaho intensified when the Idaho Legislature considered moving the state university from the north to the south. Senators and representatives from the north urged the secession of the Panhandle, and some southern legislators joined the movement. The name "State of Lincoln" was again suggested (Fig. 3c). A bill to divide Idaho passed the Idaho House of Representatives but failed to obtain a majority vote in the Senate.[15] The three proposals illustrated in Figure 3 are examples of several dozen attempts to alter Idaho's boundaries.[16]

The Idaho North and South Highway

On a continental scale several well-known railroads have been built, at least in part, for political reasons—the first transcontinental railroad in the United States linked the Pacific Coast with the East politically as well as economically. On a smaller scale Idaho has need of a similar unification. A direct railroad between the sections has often been proposed and vigorously argued; it has not been built because of the expense of running a line through the rugged terrain and because of the probable light traffic. However, a North and South Highway has been constructed and has, in the opinion of many observers, lessened the strife between the Panhandle and southern Idaho.

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[13] *Congressional Record*, 49th Congr., 1st Sess., 1886, p. 1709.

[14] W. F. Meier: Will There Be a New State—Lincoln? *World To-Day*, Vol. 12, 1907, pp. 400–403; and H. W. Scott: Proposed Readjustment of State Lines, *The Oregonian*, Portland, Oreg., June 13, 1907, reprinted in H. W. Scott: History of the Oregon Country, compiled by L. M. Scott, 6 vols., Cambridge, Mass., 1924, Vol. 3, pp. 119–122.

[15] Kingston, *op. cit.*, pp. 290–291.

[16] Boundary changes for Idaho are discussed in more detail in Kingston, *op. cit.*, and in B. E. Thomas: Political Geography of Idaho (Diss., Ph.D., Harvard University, 1947).

As early as 1872 the Idaho Territorial Legislature petitioned Congress to construct a military road from Boise to Fort Lapwai, near Lewiston.[17] Such a road, it was believed, would permit the rapid shifting of troops between the two settled parts of the territory to combat sporadic Indian attacks. The road was also to unify the territory and to aid in the economic development of the natural resources. The requested appropriation was not granted, however, and Idaho passed through the 1870's and 1880's with only a few local attempts at building the projected route. Numerous proposals for state boundary changes were made in this period, and the lack of a road between north and south was often cited as a reason for difficulties that arose between the two sections.

In 1889 the two sections joined forces to gain statehood, and a north-south wagon road was authorized.[18] Little actual work was done, however, and 10 years later provision was again made for a road over much the same route.[19]

Throughout this early period the difficulties and costs of construction and maintenance were consistently underestimated. Only small funds were available. Old sections of the road often deteriorated faster than new sections were added, and the obstacles encountered before the road finally joined the Panhandle with southern Idaho were enormous. It is hard to say whether physical or political difficulties were more retarding.

The road ran through uninhabited mountains, which of course provide neither funds for construction, nor freight, nor travelers. Opponents argued that other types of road were more justified, such as feeder roads to the growing railroad net, farm-to-market roads, or roads between towns in agricultural districts. The continual demands on the state treasury for road funds were alarming.

By 1913, when automobiles began appearing in numbers, the road had been discussed and worked upon for 40 years. But there was still no through route. A "road" extended almost the entire distance, to be sure. It was fairly good in the farming areas, but hardly passable through the rugged mountains. In some places the grades were more than 30 per cent. Along streams much of the road was submerged during high water. Wooden bridges (in

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[17] Council Memorial No. 3, Seventh Session, Idaho Territorial Legislature, *Laws of Idaho Territory*, Boise City, 1872.

[18] "An Act to Provide a Wagon Road from Mt. Idaho to Little Salmon Meadows," Fifteenth Session, Idaho Territorial Legislature, *Laws of Idaho Territory*, Boise City, 1889.

[19] "An Act to Provide for the Internal Development of the State by the Construction of a System of Wagon Roads in the Counties of Boise, Custer, Lemhi, Idaho, Shoshone, Kootenai, Latah, and Nez Perce, and Providing Funds for the Construction of Said Wagon Roads by the Issuance of a Series of State Road Bonds," House Bill 82, Fifth Session, Legislature of the State of Idaho, Boise, 1899.

the few places where they were provided) were washed out regularly and required much time for reconstruction. Snowslides, floods, and falling rocks intermittently covered or destroyed parts of the narrow roadbed. People traveled between the northern and southern parts of the state by way of the railroad through Washington and Oregon.[20]

In 1913 a survey revealed that, contrary to former opinions, the construction of an effective north-south highway would be both difficult and expensive. But the increasing importance of the automobile gave renewed vigor to the project. A steel bridge with a span of 240 feet was built across the Salmon River in that year, and contracts were let for other bridges. Four major physical problems remained: to cross White Bird, Culdesac, and Lewiston Hills, climbs of two or three thousand feet in a few miles would be necessary; and at the Salmon River Canyon 32 miles of highway would have to be blasted out.

By 1915 work was well begun. It proceeded with various delays and stoppages as costs, including those of repairs and improvements, rose and funds were exhausted. In 1928 the problem of deterioration led to the decision to apply a hard surface, and in the same year a beginning was made at removal of snow, which had previously blocked the road during the winter. By 1933 a satisfactory road had been built over most of the route, though parts of it were only rough gravel surface. Construction since that time has been devoted to straightening and widening and to hard-surfacing of the graveled sections.

The North and South Highway, after having been a major problem of Idaho for almost 70 years, is now a reality. Since about 1938 it has been used for travel between the Panhandle and southern Idaho in preference to highway routes through Washington and Oregon. Undoubtedly it contributes toward lessening the sectionalism that formerly existed;[21] but it achieves only a partial victory over the mountain barrier. The winding route and numerous grades add to both distance and traveling time. It is a good day's drive by automobile from many northern points to the state capital—possibly 450 to 500 miles. The North and South Highway itself is 712 miles long: 526 miles on the main route and 186 miles of alternate routes.

THE STATE-UNIVERSITY PROBLEM

The location of institutions of higher learning in Idaho has been a constant

[20] G. C. Hobson, edit.: Idaho Digest and Blue Book, Caldwell, Idaho, 1935, pp. 493–494; and *First Biennial Rept. Idaho State Highway Commission*, Boise, 1914.

[21] The use of air transportation between northern and southern Idaho since World War II suggests that this means of travel may soon equal the North and South Highway as a unifying force in the state.

and baffling problem. The system of colleges was started in 1889. At that time north and south had come to an agreement to seek statehood with the established boundaries rather than to continue the futile attempts at separation. In the interest of harmony, and as a compensation to northern Idaho for the earlier loss of the capital, the University of Idaho was established at Moscow, in the north. But most of the people were then, as now, in the south. The university, it was hoped, would attract students from all parts of the state and thus serve as a unifying force. A few years later, in 1893, provision was made for two state normal schools—one for the north, at Lewiston, and one for the south, at Albion.

The three schools soon became the subject of sectional disputes. Why should the Panhandle, with a minority of the population, have two colleges while the south had only one? How could students from the growing southeastern settlements obtain education in science, business, law, or engineering? The southern normal school offered nothing for them, and the university in the north was hundreds of miles away; it was easier to attend colleges in adjacent states.

A movement was started for a state educational institution in the southeast, and in 1901 the "Academy of Idaho," with high-school and business-college courses, was established at Pocatello. As the area increased in population, the school grew; industrial and technical courses were developed, and in 1915 the school was designated the "Idaho Technical Institute." Then, in 1927, after continued agitation for a four-year college and struggles against the forces that desired only one university, the Pocatello school became "The Southern Branch of the University of Idaho." This was a compromise: two years of junior-college work was established in liberal arts and education.[22]

Meanwhile the University of Idaho at Moscow had increased its faculty from two to 200 and had organized the usual colleges and departments for a state university of two or three thousand students. Work was offered through the master's degree in various fields. Obstacles to growth and improvement (besides the purely political and financial difficulties) were the location of the school far from the center of population, the inconvenient transportation between north and south, and the existence of out-of-state competing institutions. Utah has several colleges readily accessible from southeastern Idaho; only nine miles west of Moscow (at Pullman, Wash.) is the State College of Washington.

[22] C. J. Brosnan: History of the State of Idaho, rev. edit., New York, 1935, p. 338; and Federal Writers' Project, Idaho: The Idaho Encyclopedia, Caldwell, Idaho, 1938, p. 150.

A commentary on location is the "University Special" train. The "Special" starts at Pocatello a few days before each opening date of the university and picks up students on its westward journey across the state and through eastern Oregon and Washington to Moscow. The return is made when the university closes for vacation. A one-way journey takes 24 hours,[23] the railroad traveling time from New York City to Wisconsin—a long trip for a student attending his "local" state university. It gives Idaho the dubious distinction of having the longest known route for a regular student train.

Despite the special train and the North and South Highway, only a small percentage of students were attracted to the university from southeastern Idaho. Agitation for a four-year school at Pocatello continued. In 1930 a four-year course in pharmacy was inaugurated, but the other courses remained at the two-year level.[24] Each session of the Idaho Legislature struggled with the university question. Finally, in 1947, the Southern Branch was changed to the four-year Idaho State College,[25] and the two normal schools were made four-year state teachers colleges.[26] The history of the Pocatello school parallels that of the University of California at Los Angeles, another college in the southern part of an elongate state with north-south sectional tensions.

It remains to be seen whether the pair of universities are the solution to Idaho's problem of higher education, or merely a new phase of the north-south struggle, in which each section will sponsor its own university at the expense of the sister school on the other side of the central mountains.

The attempts to change boundaries, the North and South Highway, and the disputes over state institutions of higher education are three examples of internal problems associated with awkward state boundaries that enclose a central barrier and sharply contrasting regions.

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[23] Time from "Schedule of the University Special," *Idaho Statesman*, Boise, Sept. 15, 1946.

[24] Federal Writers' Project, *loc. cit.*

[25] Senate Bill No. 70, Twenty-ninth Session, Legislature of the State of Idaho, Boise, 1947.

[26] Northern Idaho College of Education, at Lewiston, was established by House Bill 89, and Southern Idaho College of Education, at Albion, by House Bill 90.

THE FUNCTION OF MELTWATER IN CIRQUE FORMATION: A REPLY

W. V. LEWIS

SUCH are the exigencies of war transport that a criticism of my paper "The Function of Meltwater in Cirque Formation," published in the *Geographical Review* for January, 1940,[1] reached me first via New Zealand. The criticism, by Douglas Johnson, appeared in the *Journal of Geomorphology* for October, 1941.[2] At that time the *Journal of Geomorphology* was not being sent to Britain because of the many sinkings in the Atlantic, but reference to the criticism was made in C. A. Cotton's "Climatic Accidents," published in New Zealand in May, 1942. Four years elapsed before I was able to read the criticism itself. Then it became necessary to visit Norway in order to check certain of the points raised by Johnson.

In the meantime the whole world of geomorphology suffered a grievous loss in Johnson's death. This tragedy might well have stayed my reply, but Johnson's criticisms were, as always, of the constructive type intended to provoke further thought and discussion. In this instance, too, he made some helpful suggestions and asked some pertinent questions. It seems fitting to follow his example and aim at reaching a more satisfactory conclusion by means of further discussion. This I do with some hesitancy because it means disagreeing with several of Johnson's views.

The case I attempted to present was, in brief, that meltwater periodically descends the headwalls of cirques, melts its way down behind the ice and into crevices in the rock, and there freezes at night or during cold spells. The material thus broken loose is then removed by the glacier, and cirque erosion proceeds mainly by this form of headwall recession. This explanation owes much to the inspiration of Willard Johnson,[3] as I was ready and eager to acknowledge. Douglas Johnson, however, wished to keep still closer to Willard Johnson's bergschrund hypothesis and to confine headwall erosion mainly to the foot of the bergschrund.

Johnson thought that I was at much too great pains to establish the reality

[1] Vol. 30, pp. 64–83. Figure references to illustrations in the earlier article are given in italics in this "reply." See also W. V. Lewis: A Melt-water Hypothesis of Cirque Formation, *Geol. Mag.*, Vol. 75, 1938, pp. 249–265.

[2] Vol. 4, pp. 253–262.

[3] W. D. Johnson: The Profile of Maturity in Alpine Glacial Erosion, *Journ. of Geol.*, Vol. 12, 1904, pp. 569–578.

➤ Mr. Lewis, University Lecturer in Geography, Cambridge, England, has been on two expeditions to Iceland and has studied glaciers in Switzerland and Norway. He was awarded the Cuthbert Peek Grant by the Royal Geographical Society for these studies.

and abundance of meltwater on the surface of glaciers in summer, which he considered was obvious. Yet Garwood,[4] whose reputation as a glacial protectionist is world-wide, built up a most elaborate and ingenious theory of step formation based on the relative absence of meltwater during glacial maxima and its abundance during the interglacial periods. Furthermore, I was asked to give my reasons for asserting that this water melts its way down below the bottom of the bergschrunds and other crevasses in a glacier.

Need of Field Evidence

First let us consider the need to present the evidence for meltwater on cirque walls and glaciers. Here, and elsewhere, Johnson seems to question the need for presenting field evidence in some detail. He says: "A single paragraph would suffice to present all pertinent data on more superficial melting and subsequent descent of meltwater." Johnson clearly missed my reason for emphasizing the abundance of meltwater in summer. "In the nature of the case it is difficult, perhaps impossible," he writes, "to prove that meltwater can penetrate so deeply before it freezes again. But the author's conviction that it does do so implies some reason or reasons for that conviction." My conviction is based on the physical fact that it takes 80 calories to freeze every gram of water, i.e. 80 per cent of the heat required to raise one gram of water from freezing point to boiling point. When a large volume of meltwater pours into meltholes and crevasses or dives under a glacier, it must either remain in the liquid state or lose vast stores of heat on freezing. How can these vast stores of heat escape under a glacier without causing an equivalent amount of melting of the glacier? Ahlmann, Sverdrup,[5] Seligman,[6] and others have demonstrated beyond question that our great mountain glaciers, except for the upper 10 or 15 meters, are permanently at the melting point, even though the mean annual temperature may be well below 0° C. Heat in quantity cannot pass from water at 0° C. to ice at the same temperature; hence there is no known means of freezing large quantities of water deep down in a temperate glacier. This applies to present glaciers as far north as Spitsbergen[7] and can be safely assumed to have applied to British glaciers throughout most of Pleistocene time. The freezing of meltwater is rendered still more difficult by the heat that is slowly but constantly passing out from

[4] E. J. Garwood: Features of Alpine Scenery Due to Glacial Protection, *Geogr. Journ.*, Vol. 36, 1910, pp. 310–339.

[5] H. U. Sverdrup: Scientific Results of the Norwegian-Swedish Spitsbergen Expedition in 1934, Part III, *Geografiska Annaler*, Vol. 17, 1935, pp. 53–88.

[6] Gerald Seligman: The Structure of a Temperate Glacier, *Geogr. Journ.*, Vol. 97, 1941, pp. 295–317.

[7] A. R. Glen: The Oxford University Arctic Expedition, North East Land, 1935–36, *Geogr. Journ.*, Vol. 90, 1937, pp. 193–222 and 289–314.

the surface of the earth. It is estimated that this causes about one-third of an inch of the bottom of a glacier to melt each year.[8]

Plasticity of Ice under Pressure

The proof, therefore, that water descends to depths below the bottom of the bergschrund depends on the evidence of the reality and abundance of meltwater pouring into the glacier. These copious supplies of water must melt their way down until the pressure of the overlying ice is such that tunnels cannot remain open but collapse because of the yielding of the ice. The depth at which this plastic collapse exceeds melting by the swift-flowing streams is not yet certainly known. Wartime researches on iceberg aircraft carriers[9] confirmed what had been previously suspected: the pressure of about 200 feet of ice is sufficient to change ice from the normal relatively rigid state to a more plastic consistency. This has altered the whole theory of glacier movement and offered geomorphologists a new approach to the subject.[10] One of the major results of this advance in our knowledge is that it is believed that vertical ice cliffs cannot exceed 200 feet in height.[11] Vertical faces of a greater height would subside by the squeezing out of the lower layers of ice. If this is true, crevasses cannot substantially exceed 200 feet in depth unless either some agent is at work deepening the crevasse as quickly as it closes by the squeezing together of the sides under plastic collapse, or the temperature of the ice is below 0°C. A similar restriction on maximum depth should apply to meltwater tunnels, but not with equal force, because melting by streams may well keep pace with plastic collapse, and the water in the tunnels may be under considerable hydrostatic pressure and thus help the walls to resist collapse.

Deductions, however, even from reliable laboratory work, will not help us answer Johnson's criticisms as convincingly as direct field observations will. Since Johnson wrote, major advances have been made in this direction by Carol[12] and a few courageous associates. They followed meltwater tunnels

[8] T. C. Chamberlin: A Contribution to the Theory of Glacial Motion, *in* The University of Chicago Decennial Publications, First Series, Vol. 9, 1904, pp. 193–206.

[9] M. F. Perutz: A Description of the Iceberg Aircraft Carrier and the Bearing of the Mechanical Properties of Frozen Wood Pulp upon Some Problems of Glacier Flow, *Journ. of Glaciology*, Vol. 1, No. 3, 1948, pp. 95–104.

[10] See F. E. Matthes: Glaciers, *in* Hydrology (Physics of the Earth, Vol. 9), edited by O. E. Meinzer, New York and London, 1942, pp. 149–219; reference on p. 189.

[11] From his Alaskan experience Mr. W. O. Field, Jr., believes this height can be exceeded. See his "Glacier Recession in Muir Inlet, Glacier Bay, Alaska," *Geogr. Rev.*, Vol. 37, 1947, pp. 369–399; ref. p. 394.

[12] Hans Carol: Beschreibung einer Gruppe von Gletscherrandklüften am Obern Grindelwaldgletscher, *Mitt. Geogr.-Ethnogr. Gesell. Zürich 1943/44 und 1944/45*, Vol. 42, 1945, pp. 12–51; *idem:* Über einen Versuch, den Gletscheruntergrund mittelst Einstiegs durch ein Strudelloch zu erreichen, *Die Alpen*, 1945, No. 6, pp. 1–6.

penetrating the Ober Grindelwald Glacier and descended to a depth of 72.5 meters. At this point their advance was stopped by a dangerous constriction filled with water, but their explorations led them to conclude that the tunnels continued down to the bottom of the glacier, 150 to 200 meters below the surface (Fig. 1).

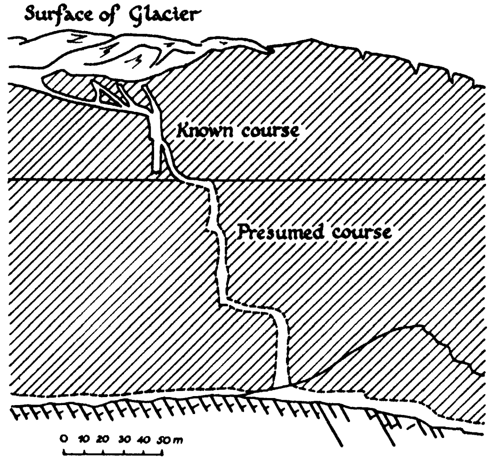

FIG. 1—Meltwater tunnels in the Ober Grindelwald Glacier (after Carol).

Here, then, is evidence for which Johnson rightly asked.

Carol[13] also descended crevasses between the side of the glacier and the rock wall to a depth of 50 meters. This depth was sufficient for the ice in places to attain the plastic state. Also, on the downstream side of a *roche moutonnée* Carol noted the results of thaw-freeze processes, and he emphasizes their importance.

In spite of my advocacy of melting where rain or heat from the sun can penetrate, I expressed doubts about the possibility that much melting occurs at the bottom of a bergschrund 150 feet deep. Willard Johnson obviously saw moisture and evidence of melting on the rock and ice at the bottom of the bergschrund that he descended, and satisfied himself that at least some of the meltwater was forming *in situ* and not seeping down from above. This is a distinction that it is very difficult to make under field conditions. In interpreting Willard Johnson's observations I was both aware of this difficulty and activated by a wholesome respect for physical laws. Where is the necessary source of heat 150 feet down a bergschrund, far from the rays of the sun and even from warm air? Warm air cannot displace the heavy cool air at the bottom of a deep crevasse and thus bring down a supply of heat from above. The theory that invokes a downdraft of warm air can apply only to small glaciers, because tunnels cannot remain open deep down under the ice unless they are filled with water under great pressure, in which case there could be no escape for the air.

IMPORTANCE OF PHOTOGRAPHS AS EVIDENCE

Johnson then criticizes my illustrations as being irrelevant and failing to indicate what was intended. One singled out for special censure is, strangely

[13] *Idem:* The Formation of *Roches Moutonnées*, *Journ. of Glaciology*, Vol. 1, No. 2, 1947, pp. 57–59.

FIG. 2—A tongue of ice formed from water that had poured through a melthole which followed the boundary between the rock and the ice above the bergschrund; the photograph was taken in a tunnel at the Jungfraujoch, Switzerland.

enough, a close-up of a typical bergschrund (*Fig. 5*). It is scaled by a facing map, 1:31,250, showing contours at 50-meter intervals and taken from a careful plane-table survey on the scale of 50 meters to the inch. Many of my photographs were taken under somewhat difficult conditions, and there are numerous imperfections; but I should like to say a few words in their defense. In physical geography, as in other branches of the subject, photographs are of immense value in helping the reader to visualize field conditions. Geomorphological controversy is all too often clouded because the protagonists do not envisage the same thing. The sure lens of the camera checks the somewhat biased eye of the observer in the field. I urge our young men to go in search of field evidence—to the end of the earth if necessary—and to bring back that evidence in a form that permits judgment by others.

One of my photographs (*8*) showed water streaming out of crevices in the rock forming the headwall of a bergschrund; another (*13*), the rock wall in a bergschrund partly covered with ice and firn; and two close-up flashlights taken under the ice showed lobes of ice lapping down a rock face, and ice occupying numerous cracks from an inch to a foot wide in the headwall above a bergschrund (*14-15*). Thus in one example meltwater was shown, and in others ice was shown, occupying cracks in the rock wall. Yet these together with my explanations in the text drew from Johnson the words: "No facts given forbid the interpretation that the thin coating of ice resulted from condensation and freezing of moisture in the air."

One cannot, of course, give all the evidence in a single paper and far less publish as many photographs as one would wish. Figure 2 is a photograph taken in the tunnel at the Jungfraujoch, alongside one of the previous photographs. This tunnel leads through the rock from the underground station within the mountain, then through the ice above the bergschrund, and out on the glacier. It may help to prove better than the previous photographs that the ice on the rock, in the main, resulted from the freezing of meltwater. The photograph shows a melthole two feet in diameter where the ice met the

rock wall, but the water that once flowed through it and down on the wooden casing of the tunnel is frozen hard. This example was repeated in places near by and strongly supports the view that much of the ice which draped the rock face with bulbous tongues and occupied large and small cracks alike was due to the freezing of meltwater.

Depth of Bergschrunds

Throughout Johnson's criticism he implies that a bergschrund is a gaping crevasse 150 feet or more deep. Most bergschrunds are not nearly that depth. Seligman states[14] that he has never seen a crevasse deeper than 30 meters, and few possess his knowledge of Alpine glaciers. The researches on iceberg aircraft carriers referred to above put the maximum theoretical depth at about 200 feet. Thus it appears that there is a definite limit to the depth of open crevasses; Willard Johnson seems to have chosen an unusually deep bergschrund for his justifiably renowned descent. At the end of the summer, when most of the winter's snow has been removed, the bergschrunds in the glaciers with which I am familiar are usually from 5 to 50 feet deep.

Johnson goes even further in the matter of bergschrund depth and criticizes also Bowman's important observation on Andean glaciers that all the bergschrunds do not reach to or near the rock wall of the cirque.[15] "We do not know," Johnson states, "that these shallower bergschrunds of present day glaciers are properly representative of those bergschrunds supposedly responsible for cirque quarrying in earlier times." This type of argument is fraught with danger. One can at the present day visit places experiencing a great variety of glacial climates, and he would be a bold man who would assert that the climate of Britain—or of anywhere else— in Pleistocene time cannot be matched in some part of the world today. In areas such as Iceland and Norway climates can be found that, to judge from general climatological considerations, probably approximate those of Britain during much of the Pleistocene Ice Age. Therefore if one appeals to a hypothesis of very deep bergschrunds, one should look for them in countries where the relief also is comparable. Deep bergschrunds may yet be found because vision, falling boulders, and sounding lines can all be impeded by snow bridges. Whatever future discovery may reveal in the matter of deep bergschrunds—and one must not rule out the possibility of considerable local deepening by meltwater streams—we have no reason to assume that the physical properties of

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[14] G. Seligman: Extrusion Flow in Glaciers, *Journ. of Glaciology*, Vol. 1, No. 1, 1947, pp. 12–21; reference on p. 15.

[15] Isaiah Bowman: The Andes of Southern Peru, New York, 1916, p. 295.

ice in Pleistocene time differed from those of today. The ice in the glaciers, as in those of today, must have yielded plastically under stresses such as are experienced by a block of ice 200 feet down in a glacier, but with one face open to the air. Consequently the crevasses in the Pleistocene glaciers, as in those of today, could not have greatly exceeded 200 feet. The only qualification necessary would seem to be that the glaciers should have been near the margins of the great ice sheets then existing, and with similar temperature distributions to those of the corresponding glaciers of today.

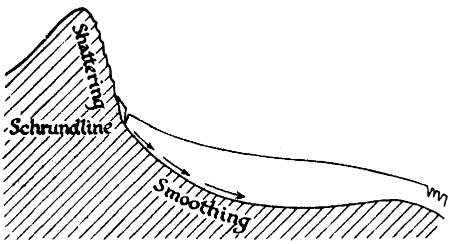


FIG. 3

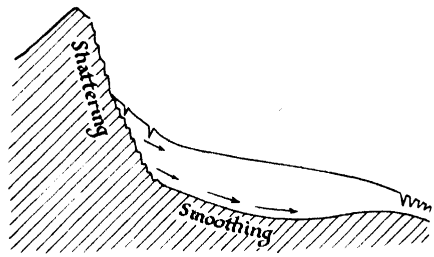


FIG. 4

FIG. 3—Cirque profile according to the bergschrund hypothesis.
FIG. 4—Profiles of a typical well-developed British cirque with the glacier added so as to demonstrate the meltwater hypothesis.

SURFACE GRADIENT OF CIRQUE GLACIERS

A further major criticism that Johnson levels at my paper concerns the surface gradient of cirque glaciers. Johnson takes up this matter in his alternative theory of cirque formation. Figures 3 and 4 are from my previous paper. Figure 3 shows a profile not infrequently found in British cirques, and the glacier is added to demonstrate the bergschrund hypothesis. Figure 4 represents the profile more typical of a well-developed British cirque that I considered would be better explained on the meltwater hypothesis. Johnson suggests that I chose the surface gradient of the glacier to suit my hypothesis. Actually, the gradient was drawn (*a*) to conform with the surface gradients of present-day glaciers and (*b*) to enable the ice to move up the reversed slope out of the cirque. This gradient is representative for glaciers of the size indicated, as is also the slope of the cirque floor. Both the surface and bed gradients can be checked against existing glaciers and ice-free cirque floors.

The essence of Johnson's criticism is the thickness I gave the ice at the headwall in Figure 4. Had I illustrated a cirque floor that, when the ice disappeared, would contain a lake reaching to the headwall—a common occurrence—this thickness would have been substantially more. The con-

touring of cirque floors is not good on the otherwise excellent Ordnance Survey one-inch maps of Britain. It is better on the newer 1 : 50,000 Norwegian maps, but even on these maps, which set a high standard in accuracy and clarity of contours, it is not always reliable. I purposely avoid for this comparison the excellent new Swiss 1 : 50,000 maps, because neither the

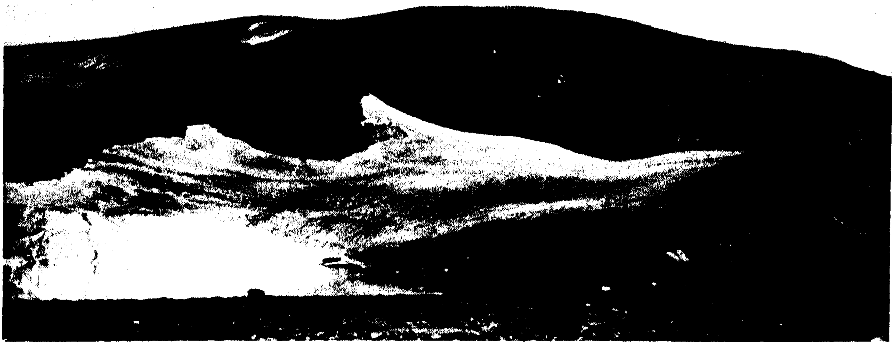


FIG. 5—Cirque and glacier near Juvasshytta in the Jotunheim, Norway. The headwall is vertical for over 500 feet and consists of a resistant, light-colored gabbro.

relief nor the climate of Switzerland resembles conditions that would have obtained in Britain during Pleistocene time.

If we select British cirques containing a lake that abuts against the headwall, we know, irrespective of the quality of the contouring, that the shore line of the lake is horizontal. Further, if from the outlet of the lake we assume an upvalley gradient representative of those of glaciers occupying cirques of the same size and general disposition today, we get a value for the thickness of the glacier at the headwall when the ice just reached the outlet of the lake. The Jotunheim is well suited for such comparisons because the range of height from the peaks at about 8000 feet to the general surface of the Norwegian plateau at 5000–6000 feet is almost the same as the range in British mountains. In both 1946 and 1947 I measured the surface gradient of a number of cirque and other glaciers in the Jotunheim and found that it usually ranged between 12° and 25°, the larger ones being less steep. The gradient invariably inclined steeply upward as the headwall was approached.

The 1: 50,000 sheet Midt-Jotunheimen is worth studying in this connection. The average surface gradient of the cirque glaciers in Kjedlen (Fig. 5) near Juvasshytta, in Skauthöe east of Spiterstulen, in the neighboring cirques in the northeast face of Spiterhöe, and in the four cirques tributary to the Heillstuggubreein valley—a fairly representative series—is 1:3 (18° 30′).

A cirque glacier that has breached the dividing wall and overflowed into a neighboring lower cirque shows a far gentler gradient; but as such glaciers present special conditions, they should not be used for this comparison.

Somewhat larger glaciers occupying valleys that could be matched in Britain are heimre Illaabreein, Storjuvbreein, Styggebreein, and Heillstuggubreein. These have a surface gradient of about 1:7 (8°).

TABLE I—ESTIMATED HEADWALL THICKNESS OF ICE IN REPRESENTATIVE BRITISH CIRQUES

Column A: Assumed gradient of glacier. Column B: Thickness in feet at headwall.

	A	B		A	B
Cairngorms			*North Wales*		
Loch Einich	1:6	1,250	Llyn Dulyn	1:3	420
Coire an Lochain	1:3	350	Melynllyn	1:3	340
Dubh Lochan	1:3	350	Ffynon Llugwy	1:3	700
Loch nan Eun	1:3	400	Marchlyn Mawr	1:3	600
Lochnagar	1:3	530	Llyn Idwal	1:4	730
			Llyn Glaslyn	1:3	560
Lake District			Llyn Llydaw	1:4	975
Red Tarn	1:3	550	Llyn Arenig Fach	1:3	400
Easedale Tarn	1:3	600	Llyn Arenig Fawr	1:3	700
Stickle Tarn	1:3	340	Llyn Cader	1:3	350
Angle Tarn	1:3	200	Llyn Cau	1:3	620

Table I has been prepared with these values of surface gradient as a guide in estimating the thickness of the ice against the headwalls of 20 representative British cirques when the glaciers ended at the present outlets of the corrie lakes.

These values must, of course, be used cautiously. The thickness is that where the lake or lake flat meets the headwall—presumably the schrundline of the bergschrund hypothesis—and at a time when the glaciers failed to emerge from their cirques. Few would assert that the glaciers did their main work when they only just reached the lip of the cirque. If one assumes that a glacier a hundred feet or more thick passed over the lip, then the thickness of the glacier at the headwall must be increased by nearly 100 feet. In several cirques the lip over which the bulk of the ice had to rise was well above the level of the lake—more than a hundred feet at Easedale Tarn—and this would again increase our estimate of the thickness of the glacier when it flowed out of the lake basin.

Even when allowance is made for inaccuracies and for any overestimate of glacier gradients, it nevertheless seems that the thicknesses given in Table I are such that, with the exception of Angle Tarn, no bergschrunds could have reached the foot of the headwall when the cirques were occupied by active glaciers. Nor can we accept Johnson's criticisms of the surface gradient shown in Figure 4; for this averages 12° (1:4.7), which is comparable with that of

similar cirque glaciers today. Had Johnson examined more closely the photographs and maps in my paper, he should not have been so misled in his estimate of glacier gradients. The photograph he most criticizes (*5*) shows a surface slope above the bergschrund of nearly 40°. Similar slopes both at and below the bergschrund are shown in a photograph of the northwest twin cirques of Snaefell (eastern Iceland) (*6*) and on the left side of a close-up of part of the southern of these cirques (*7*). Slopes of this order are clearly visible and measurable in a photograph of the upper reaches of the Jungfraufirn (*9*), in one of its south face, and in two of the southwest face of the Mönch (*11–12*).

Equally unfortunate is Johnson's failure to read the surface gradients of the glaciers in the northeast cirque and the northwest twin cirques of Snaefell shown on the maps published with the paper. These glaciers slope at about 40° near the headwalls, but lower down, the main glaciers, extending for nearly a mile, slope at about 15°. The values are consistent with those given above for Norwegian glaciers. The Icelandic examples were included in my earlier paper for exactly the same reason that the Norwegian glaciers are included here—because they are probably analogous to British cirques in Pleistocene time in respect of both climate and relief.

Cirque Erosion in Active Progress

Johnson asks the question: "Is meltwater formation near the heads of present glaciers and under present climatic conditions properly comparable with what took place in a different climate when cirque cutting was at its maximum? Is cirque development still actively in progress in regions studied by modern investigators?"

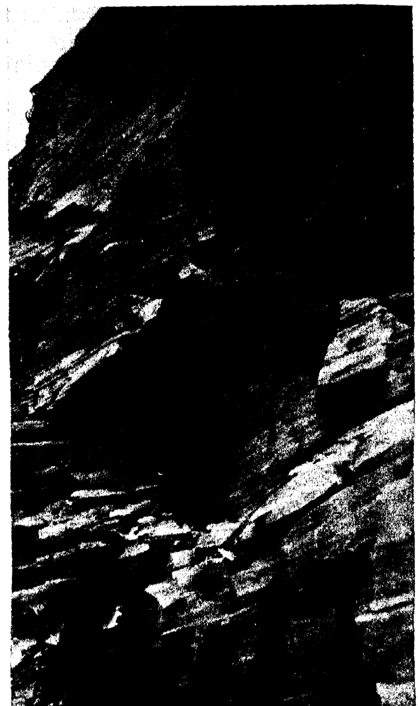
In matching present glacial climates with those of the past one must, of course, proceed with caution, but one should not be so hesitant as to avoid field examination of present glaciers. To the second question, however, a more definite answer can be given. One photograph in my previous paper, taken in a bergschrund at Snaefell (*8*), showed massive blocks of basalt broken loose from the headwall and pushed out toward the glacier. A photograph taken above the bergschrund at the Jungfraujoch (*14*) showed the headwall riven and shattered, with large blocks of rock moved bodily a foot or more away. These together with text descriptions were intended to demonstrate that cirque erosion was still actively in progress. Willard Johnson's observations in the deep bergschrund also made this abundantly clear. But in the summers of 1946 and 1947 I saw evidence of contemporaneous cirque erosion that far exceeded anything I had seen, or read of, before.

Figure 6 shows the head of an elongated cirque, Smedbotn, in the Rondane district of eastern Norway. Only a diminutive glacier now remains, lying steeply against the headwall. The photographs forming Figure 7 were taken at the point indicated by the arrow in Figure 6, where the glacier met a part of the headwall almost surrounded by névé. The rock is sparagmite, a

FIG. 6—The head of Smedbotn, an elongated cirque in the Rondane, Norway, showing the end moraine of the 1760 advance and the present diminutive glacier sloping steeply up in the headwalls. (Photograph by Louis L. Ray, U. S. Geological Survey.)

slightly metamorphosed sandstone, which, to judge from the magnificent cliffs that flank the cirque, is fairly resistant. The destruction was astonishing. The headwall for more than 50 feet vertically had broken apart. Blocks weighing hundreds of tons had moved bodily several feet down toward the glacier, a movement favored by the structural dip. Everywhere meltwater dripped from snow on the rock face far above, and in a shady gully broken fragments of stones of all sizes were held together in a matrix of ice from which hung numerous icicles (Fig. 8).

The glacier ended at a chaotic zone of boulders many acres in extent. This end moraine had been pushed up by the glacier's advance, which culminated in 1750–1760. It rose nearly 200 feet above the lake and represented an enormous volume of rock. Professor W. Werenskiold and other Scandinavian authorities believe that the Norwegian glaciers entirely disappeared in the Bronze Age; hence this end moraine may represent the work of a diminutive cirque glacier acting for about 3500 years. At the most it can only represent the work of such a glacier for about 10,000 years. When one



Figs. 7 and 8—Details of the head of Smedbotn. Figure 7 (immediately above) shows where the headwall (see Fig. 6) has recently emerged from under the névé owing to the rapid diminution of the glacier. Blocks weighing hundreds of tons had been thrust several feet out from the headwall, and the whole cliff face was fragmented and shattered.

Figure 8 (upper left) shows shattering by repeated freezing of meltwater in a sheltered gulley alongside the cliff shown in Figure 6. The debris was held together by a matrix of ice, and meltwater trickled down and dripped from the icicles.

FIGS. 9 and 10—Skauthöe cirque, the Jotunheim. Figure 9 (upper left) shows great slabs of gabbro broken loose from the headwall ready to be carried away by the glacier. Figure 10 (upper right), from the same point as Figure 9, shows the rock wall of the gaping randkluft broken apart along faces which did not coincide with any obvious structural weaknesses in the resistant gabbro.

FIG. 11 (left)—The shady north-facing cliffs of the Juvasshytta cirque. The whole surface of the gabbro, exposed by the excessive summer melting of 1947, was broken into great blocks, some of which had been pushed out many inches.

looks around and notes the few changes in the landscape of such areas produced by streams and other agents since the main ice departed, the impression of the immense erosive power of the little glaciers of today is graphically confirmed.

Destruction on an almost equal scale can be seen at the head of the Skauthöe cirque (Figs. 9 and 11), together with a 1750–1760 moraine of about the same dimensions. Here the rock is a highly resistant, light-colored gabbro, and the arrangement of joint and other planes of weakness appears unfavorable for glacial sapping. The same destruction is evident also in the shady north-facing cliffs of the Juvasshytta cirque (Fig. 11), again in a highly resistant gabbro.

One may well ask why this degree of destruction failed to attract more comment in the past, since the Juvasshytta cirque is readily accessible and has

been famous ever since Richter illustrated it in 1896.[16] The reason lies partly in the fact that the present is a most favorable time for such observations, because the glaciers have been retreating for most of this century. The winter of 1946–1947, which brought so much snow to Britian, brought little precipitation to the Jotunheim, and then followed a summer of exceptional heat, in which many of the Norwegian glaciers retreated at the unprecedented rate of 30 yards a month. Thus the parts of the headwalls that we were able to examine may have been concealed and subjected to rotting and sapping by the glaciers for a long period of time.

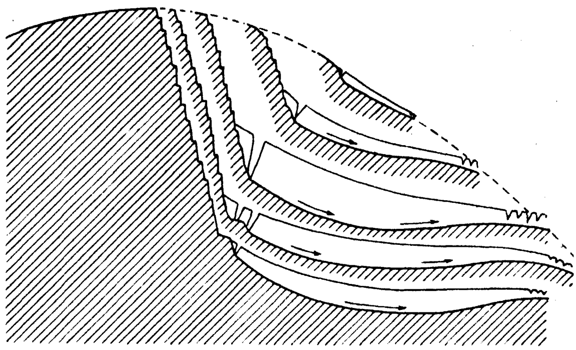


FIG. 12—Stages in the evolution of a cirque according to Douglas Johnson.

JOHNSON'S ALTERNATIVE EXPLANATION

Finally Johnson offers an alternative explanation of cirque formation, which adheres closely to the bergschrund hypothesis. It is summed up in Figure 12. It has several points of interest but also fatal weaknesses. The first and most obvious weakness is the surface gradient in the later stages of cirque erosion. Johnson gives the glacier a surface gradient of about 15° at the maximum of glaciation. This falls to 8° in the next stage, and to an over-all gradient of 7° in the last stage. These gradients, though rather gentle, are not unreasonably so; but to judge from present cirque glaciers, they should increase, not decrease, as the glacier shrinks—provided it remains active.

Far more misleading is the surface slope in the last stage. This, no doubt quite unintentionally, is very slightly reversed for a third of the glacier's length. This almost imperceptible slope occurs where the rock floor below is given a marked reversed slope. If one plots the center of gravity of the glacier in this last stage, one finds that it has to move slightly uphill for the lower half of its course. Had Johnson kept the same bed profile but given the glacier surface a reasonable slope, he would have had to represent the glacier as extending high up the headwall—far too high for the bergschrund to reach the break of slope—and this would have meant discarding the bergschrund

[16] Eduard Richter: Geomorphologische Beobachtungen aus Norwegen, *Sitzungsber. Kaiserl. Akad. der Wiss. in Wien, Math.-naturwiss. Klasse*, Vol. 105, Sect. I, 1896, pp. 147–189, Pl. 1.

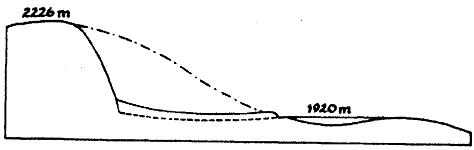


FIG. 13—The profile of the Galdhöpig cirque. (Redrawn from Cotton, "Climatic Accidents," p. 174.)

hypothesis. In fact, the glacier would have had to be shown higher above the base of the headwall than at its maximum stage, before the reversed slope formed, because a steeper surface gradient would be necessary to enable the glacier still to move forward up the slope out of the cirque basin, a phenomenon that can take place only when the ice mass involved falls in level as a result of the movement. If the lowest glacier shown in Johnson's diagram moved as a unit, the center of gravity of the whole glacier would fall slightly. But the fall would be insufficient to overcome friction, plastic drag, and other forms of resistance that the glacier would offer to motion. Furthermore, it is highly unlikely that a glacier of such dimensions would behave as a unit; the upper sloping part would tend to override the lower tongue, thus increasing the gradient of the latter. As drawn, the weight of the lower tongue gives a component force acting toward the center of the basin which would encourage movement of the tongue backward into the basin, making a most unlikely system of forces for an active glacier.

Others besides Johnson have not been careful enough in this matter of surface gradient. The illustration in Figure 13 shows the profile of the Galdhöpig cirque (the cirque near Juvasshytta; see Fig. 5) given in Cotton's "Climatic Accidents" (Fig. 58, on p. 174) and attributed to Richter. This is quite wrong. I have failed to find this profile in Richter's paper, but his sketch of the cirque, also given in Cotton's book, is remarkably accurate and shows the glacier in a state not very different from that of today. The glacier today slopes at 12° to 14° in its lower parts and at double or treble that angle near the headwall, as the party of Cambridge students that glissaded down would testify. These upper slopes are steepest toward the eastern and southern sides, where the snow mainly accumulates.

The second assumption in Johnson's reconstruction with which I cannot agree is of the existence of bergschrunds of prodigious depth during the glacial maximum. This has already been shown to be at variance with the findings of recent workers on the physics of ice. Table I makes clear to what depths the bergschrund would have to extend to account, on this hypothesis, for even the moderate-sized British cirques.

DOWN CUTTING BY CIRQUE GLACIERS OVERESTIMATED

A third weakness in Johnson's reconstruction is the assumption that a

cirque glacier lowers its bed quicker than it saps its headwall. The process of headwall sapping is beginning to be understood, and a strong case can be made for its being extremely potent. But the way in which a relatively thin cirque glacier can lower its bed at the rate envisaged by Johnson (Fig. 12) is wholly inexplicable, especially since the deepening of the floor is continued into the last stage of glacial activity, when the ice is so thin, and the gradient such, that it clearly could not move out of the cirque basin.

The Rondane district is well suited to glacial studies, because enough of the preglacial relief is preserved to enable an estimate to be made of the amount of erosion accomplished by the cirque and small valley glaciers in the Pleistocene Ice Age. The area is characterized by very long flat-floored cirques bounded by steep cliffs 1000 to 1500 feet high. Strøm[17] has analyzed this topography and has concluded that the headward retreat of the cirque glaciers has amounted to two miles or more. Strøm may have underestimated the size of the preglacial river valleys that the oncoming glaciers probably inherited, but an examination of the district in his company led me to conclude that his estimate is substantially correct. In both the Rondane and the Jotunheim one constantly finds that the cirque floors grade, without any significant break of slope, into the plateau surface—or *flye*—that surrounds the higher monadnocklike masses. As many of the cirque glaciers probably originated in the angle between the plateau surface and the upstanding masses, it does not seem that much downward erosion has accompanied their substantial recession into these masses.

Not only does Johnson seem to overestimate the downcutting accomplished by very thin and gently sloping cirque glaciers, but he also attributes to them the ability to scour out a lake basin. The basin shown in the last stage of Figure 12 has developed almost entirely since the period of maximum glaciation. No explanation is given of this surprising assertion.

Johnson in conclusion suggests a possibility that, though not new, may play a part in deep glacial erosion. It is that ice frozen to the joint-ruptured rock of a valley head pulls blocks from place without the intervention of the alternate freezing and thawing of meltwater. This form of "dry" plucking may occur under a very deep valley glacier from which water is excluded by the great pressure of the overlying ice against the rock bed, but it should be ascribed with caution to a thin cirque glacier. The reversed slope common in cirques would tend to retain water in the crevasses and meltholes below the level of the lip. The tensile strength of ice, too, is very low as compared with

[17] K. M. Strøm: Geomorphology of the Rondane Area, *Norsk Geol. Tids.*, Vol. 25, 1945, pp. 360–378.

that of rock, and overmuch allowance should not be made for the weakening effect of joints. Near the surface, weathering widens joints and other planes of weakness, but farther down, the rock is usually sound and, as any quarryman knows, needs a considerable explosive charge to break it apart.

Thrust Planes in Cirque Glaciers

Having attempted to answer Johnson's main criticisms and questions, I shall now follow his example and turn to the happier task of making constructive suggestions.

Since writing the earlier papers I have learnt more of the mechanism of glacier motion and can now offer an explanation of the basin and lip which are characteristic features of well-developed cirques, and about which I had to keep rather silent before. T. C. and R. T. Chamberlin have done excellent service in rendering familiar the thrust planes in the upper, more rigid layers of ice in glacier tongues. But the part thrust planes may play in the movement of cirque glaciers has not yet received due attention. I have referred to this matter in somewhat more detail elsewhere.[18]

The surface of the small Skauthöe cirque glacier in July, 1946, shown in Figure 14, is typical. The snow-free surface is scored with a hundred or more thrust planes that outcrop contourlike across it. Closer inspection reveals overthrusting—each layer overlapping the next below. Those in the center of the photograph dip into the glacier at 40° to 45° where the surface slope is 25°. The overthrusts frequently brought dirt and boulders to the surface. Many large angular blocks emerging from the ice revealed by their angle of dip that they had come up the thrust planes and not fallen into the glacier from above (Fig. 15). At the sides of the glacier lines of pro-talus had formed from blocks fallen on the glacier from the bounding cliffs. One line is shown in the left foreground of Figure 14 and others in the distance; the end of the 1750–1760 crescentic terminal moraine can also be seen on the right.

The thrust planes were revealed both in plan and in section in the Juvasshytta cirque glacier. They rise steeply to the surface in the ice cliff to the left of the center of Figure 5. On the ground they can also be readily traced across the surface of the glacier. The cirque faces east, and most snow now accumulates under the shady north-facing slopes. This gives a surface gradient, and causes the ice to move, diagonally across the cirque from southwest to northeast, as is indicated by the pattern of the moraines seen in the right of the photograph.

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[18] W. V. Lewis: Valley Steps and Glacial Valley Erosion, *Trans. and Papers Inst. of British Geogrs. 1947* (*Publ. No. 13*), London, 1948, pp. 17–44.

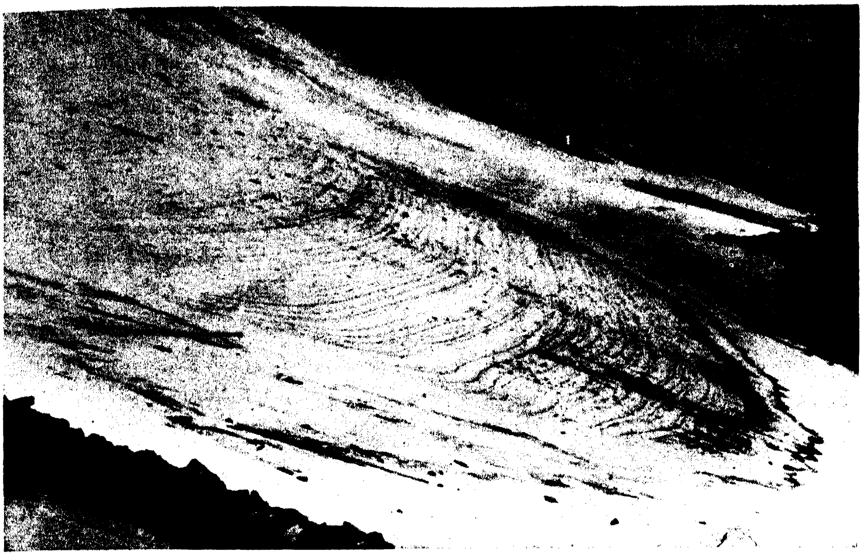

FIG. 14 (above)—A small cirque glacier, Skauthöe, the Jotunheim (summer 1946). The surface is scored by the outcrops of numerous steeply inclined thrust planes. Debris is brought to the surface along the thrust planes. The end of the crescent-shaped end moraine of the 1750–1760 advance is shown on the right.

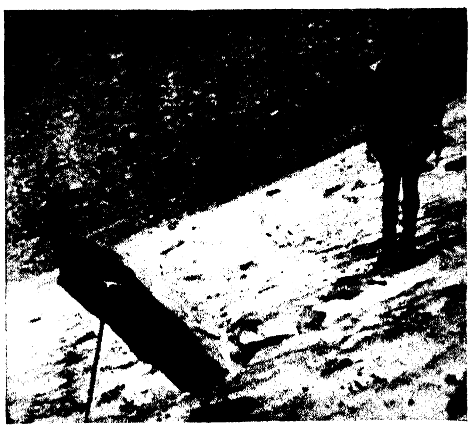

FIG. 15 (right)—A great slab of gabbro emerging along a thrust plane, and revealing, by its tilt, the inclination of the thrust plane. Directly down the glacier from Figure 14.

Figure 16 represents the glacier motion that may reasonably be inferred from this and similar evidence. The activating force is the weight of the wedge-shaped increment of snow added each year aided by the steepening of the front by melting. Dr. E. Orowan of the Cavendish Laboratory, Cambridge, has calculated that a gradient of about 12° would be sufficient for such a cirque glacier to start moving along a great arcuate thrust plane. Theoretically a single thrust plane should follow the boundary between the ice and the rock floor, but actually there are multiple thrust planes—perhaps following ice bands and the boundaries between annual layers of accumulation. Nevertheless, there is probably considerable differential movement between the debris-laden ice and the bedrock that helps to account for

erosion of the cirque floor. The tendency to form arcuate glide planes is probably the main reason for the development of the basin form with its reversed slope, because toward the sill the ice tends to move upward and so to reduce the scouring of the floor at that point. Even if the glacier filled the

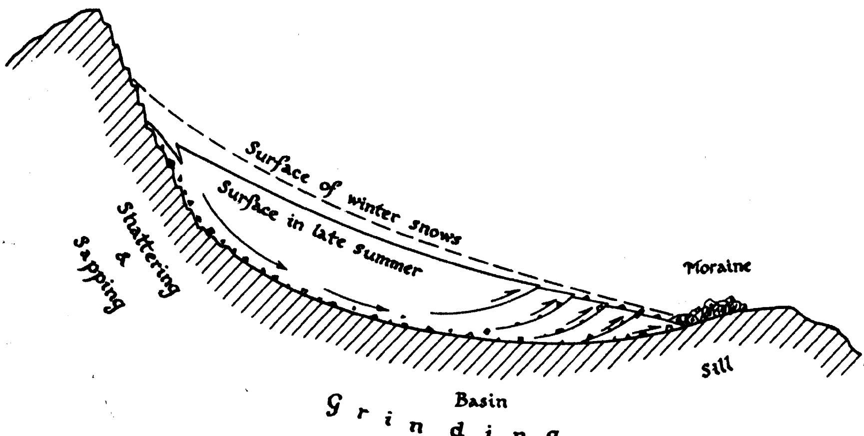

FIG. 16—The formation of a cirque basin by rotational slipping.

basin and overflowed down the slope beyond, the rotational slipping would probably still occur, with the resulting tendency to form an overdeepened basin.

This explanation applies when the glacier is less than 200 feet thick and the whole mass is relatively rigid and the thrust planes remain fairly well defined throughout. It may also apply to thicker glaciers in which the little-understood plastic yielding of the lower layers probably resembles the movement in the upper layers more closely than is suggested by recent authorities.[19]

In conclusion, I should like once more to express my feeling of loss that Douglas Johnson is no longer with us to continue his outstanding contributions to geomorphology and by his searching and helpful criticisms to spur others on to make their own smaller contributions.

[19] R. F. Flint and M. Demorest: Glacier Thinning during Deglaciation; Pt. I, Glacier Regimes and Ice Movement withing Glaciers, *Amer. Journ. of Sci.*, Vol. 240, 1942, pp. 29–66.

CHEMICAL WEATHERING AT LOW TEMPERATURES*

JOSEPH E. WILLIAMS

IN 1941 the author had an opportunity to study the small nivation depressions and associated snowdrifts on the north side of the San Gabriel Mountains, just north of Los Angeles. Analysis of ground water collected under the drifts showed that it contained calcium bicarbonate in solution. As a result of this observation, field work was undertaken, in 1947 and 1948, in the Snoqualmie Pass region in the Cascade Mountains of Washington, to investigate the problem of chemical weathering at low temperatures.

Snoqualmie Pass, elevation 3008 feet, forms the divide between the South Fork of the Snoqualmie River and tributaries of the Yakima River. Northeast of the pass the Cascades are 5500 to 7000 feet high; to the southwest they are 4500 to 6000 feet. The ridges trend in a general northwest-southeast direction and are markedly asymmetrical. On the longer and more gentle northeast slopes are numerous cirque and nivation depressions, some of them filled with lakes. Talus slopes have been built up around the bases of the rock walls of the cirques. The southwest slopes are short and steep, and the absence of cirques, nivation depressions, and deeply eroded stream valleys leaves them relatively smooth and unbroken (Figs. 2 and 3).

In Snoqualmie Pass the total precipitation is 87 inches. Fifty per cent is in the form of snow, the yearly fall averaging 398 inches. On the ridges 2000 feet above, it is probably much greater. Although the ridges are more or less transverse to the prevailing westerly, southwesterly, or southerly winds, they are not high enough to be barriers to drifting snow. Instead, the heavy snowfall of the windward slopes and the crests is drifted north-northeastward and accumulates on the leeward slopes to great depths, perhaps 40 or 50 feet on the average and greater in depressions (Figs. 4 and 5).

The first spring thaw removes the thinner parts of the snow cover and exposes the bedrock to the mechanical weathering caused by alternating freezing and thawing. As a result the surface becomes covered with coarse, angular rock fragments. This process continues longest around the margins of snow patches, where meltwater is abundant, and it has generally been assumed that such mechanical weathering, together with the removal of the

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*Condensed version of a paper read at the meetings of the Association of American Geographers, Charlottesville, Va., December, 1947, and the British Association for the Advancement of Science, Section E (Geography), Brighton, September, 1948.

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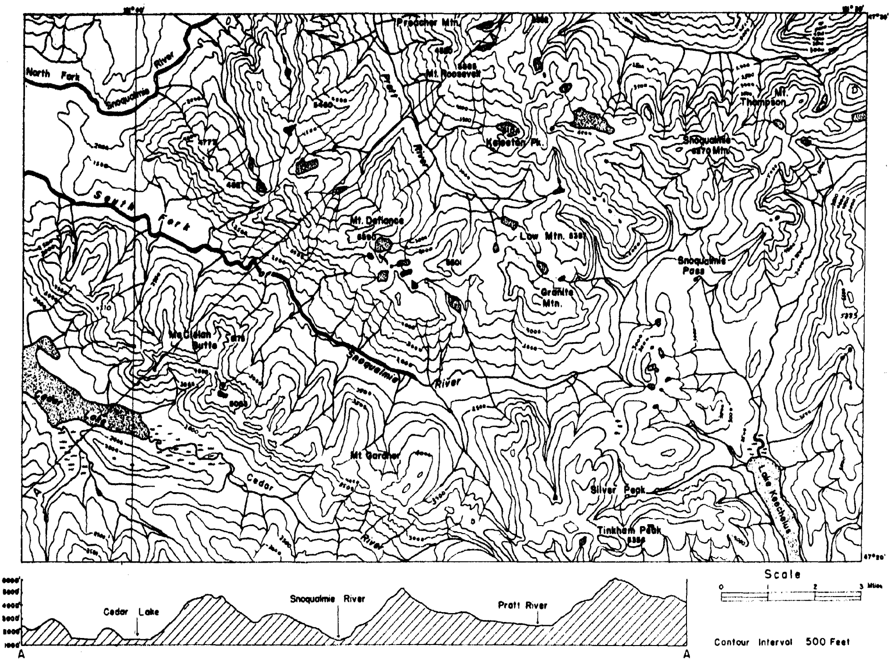

FIG. 1—Contour map of the Snoqualmie Pass region, with northeast to southwest cross section.

finer debris by rills of meltwater, forms the nivation depressions associated with snowdrifts.[1] The author's observations suggest, however, that chemical weathering under the drifts also contributes to the formation of the depressions.

Under deep drifts the minimum ground temperature is 32.5° or 33° F.; hence the ground does not freeze. Should it freeze before snowfall, it will be thawed by residual heat in the soil, retained because of the insulating effect of the snow cover. Furthermore, soil moisture will be abundant. The first precipitation after the summer dry season is likely to be rain, followed by wet snow. This saturates the soil and rock cracks, and before much drying can take place the entire mountain crest will be blanketed with snow. On warm days some of the surface snow will melt, and the meltwater will make its way down through the snow and percolate into the ground or remain at the contact between snow and ground. Rain may fall on the snowbank and move down through it in the same way. Since the drift accumulates during many different storms, with short melt periods intervening, thin layers of crust are present within it, marking the surfaces of the successive snowfalls.

[1] C. A. Cotton: Climatic Accidents in Landscape-Making, Christchurch, Auckland, etc., 1942, pp. 202–205.

These crusts slow up the percolation of water. By placing dye on the surface of the snow it was possible to determine the average rate of descent, which was found to be about one foot an hour.

Carbon Dioxide Concentration

Rain or meltwater passing slowly through the snow is close to the freezing point, the optimum temperature for the absorption by water of gases such as oxygen and carbon dioxide (see Table I). Carbon dioxide was found to

Table I—Solubility of Carbon Dioxide and Oxygen in Water*

Grains of gas needed to saturate 100 grams of water

	0° C.	5°	10°	15°	20°	25°	30° (86° F.)
CO_2	0.3346	0.2774	0.2318	0.1970	0.1688	0.1449	0.1257
O	0.006946	0.006072	0.005368	0.004802	0.004339	0.003931	0.003588

*From N. A. Lange and G. M. Forker: Handbook of Chemistry, 6th edit., Sandusky, Ohio, 1946, p. 1239.

be present in greater than average amounts in the air within the snowbanks of the Snoqualmie Pass region. Here, during January, February, and March, 1948, the snow was 10 to 12 feet deep. A glass tube eight feet long was sunk into the snow, and 23,600 cubic centimeters of air was drawn out by means of an aspirator. This air was passed through a tube of anhydrous calcium sulphate, which absorbed the moisture, and then through a tube of potassium hydroxide, which absorbed the carbon dioxide. Weighing of the latter tube before and after the air had been passed through it showed that one sample of air had contained 0.098 per cent of carbon dioxide, the other 0.077 per cent.[2] The first sample is probably more indicative of true conditions within the snow than the second, which included air that was already in the tube and air from the disturbed part of the snow. In contrast, air from Bagley Hall at the University of Washington contained only about half as much carbon dioxide, or 0.04 per cent.

The concentration of carbon dioxide in the air within a snowbank is attributed to daily freezing and thawing at the surface of the snow. Freezing of meltwater releases the carbon dioxide it has absorbed from the atmosphere. Since this is a heavy gas, it remains in the snowbank, and rain or meltwater passing through can absorb it to the point of saturation. In this way the water is provided with carbonic acid for chemical weathering. "Carbonic acid, either of atmospheric or of organic origin, is the most abundant and generally

[2] The apparatus was prepared, and the final weighing done, by G. L. Putnam of the Department of Chemical Engineering, University of Washington.

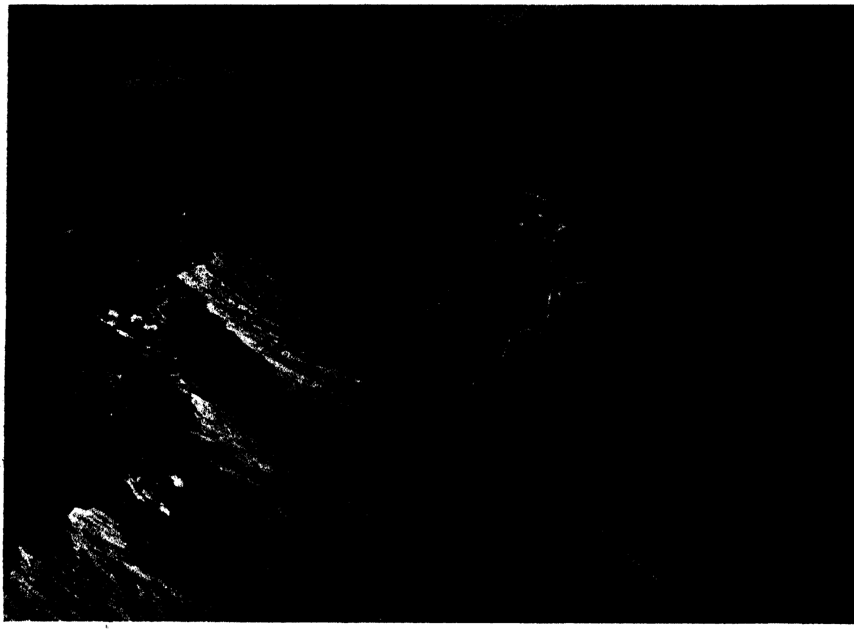

FIG. 2

FIG. 3

FIG. 2—Aerial view eastward up the valley of the South Fork of Snoqualmie River. Left or north slope smooth and right or south slope with side valleys and spurs. (Photograph by Pacific Aerial Surveys, Inc.)

FIG. 3—Aerial view eastward showing the highly dissected Cascade peneplain with the valley of the South Fork of Snoqualmie River. (Photograph by Pacific Aerial Surveys, Inc.)

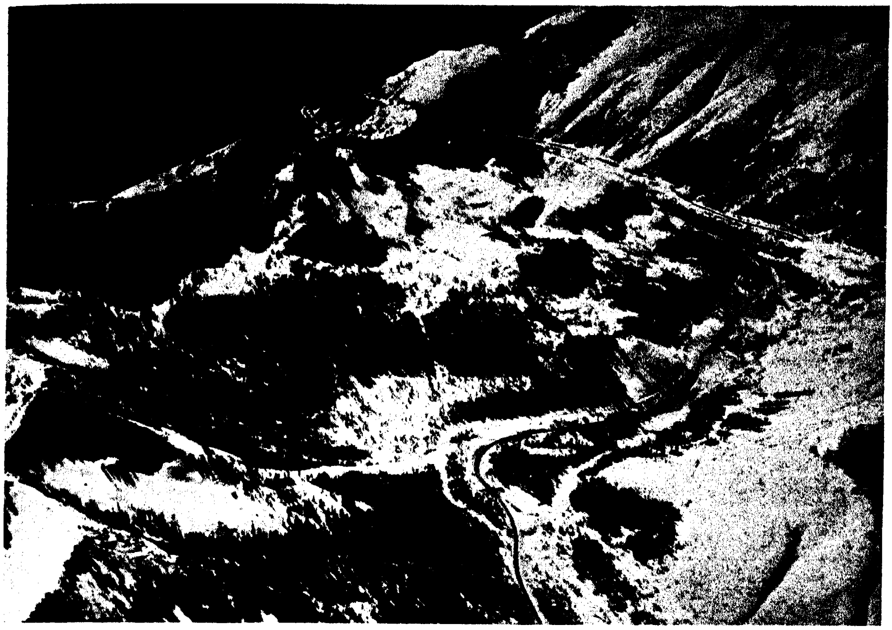

FIG. 4

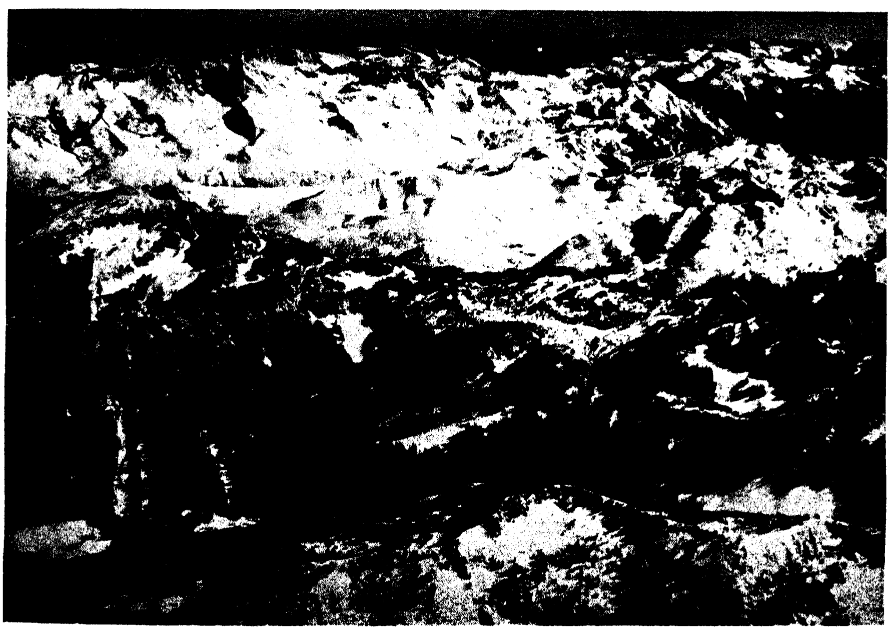

FIG. 5

FIG. 4—Aerial view of Stevens Pass, northeast of Snoqualmie, looking westward showing a ridge at the left with nivation depressions with drifted snow. Dominant wind direction is from the left. (Photograph by Pacific Aerial Surveys, Inc.)

FIG. 5—Aerial view of the Cascades showing a snow-filled nivation depression from which avalanches have cut paths from the fir forests. (Photograph by Pacific Aerial Surveys, Inc.)

the most potent of the agents that dissolve mineral matter from the rocks."[3]

The question remains: How much solution can the water accomplish at near-freezing temperatures? With a change of temperature from 30° C. (86° F.) to 0° C. (32° F.)—values that are within the normal range of air and water temperatures in nature—solubility of most compounds is somewhat reduced. This is not, however, a serious handicap geologically; for solution at a relatively slow rate when continued for many thousands of years may eventually accomplish notable results. Moreover, for no compound does solubility stop at 0° C., and for some compounds it may remain nearly constant as that temperature is approached, as in the case of sodium chloride, or may even increase, as in the case of cerium sulphate. A demonstration of increase in solubility with decrease in temperature was furnished by an experiment[4] to determine the reaction of water in equilibrium with carbon dioxide and limestone at 0° C. (32° F.) and at 22° C. (71.6° F.). Forty-eight hours was allowed for the equilibrium to be established. The results were as follows: At 0° C. the calcium content of the water was 0.43 gram to a liter; at 22° C. it was 0.40 gram. "The higher value at the lower temperature is probably due to the increased solubility of carbon dioxide at the lower temperature."[5]

TABLE II—ANALYSES OF MELTWATER FROM SNOQUALMIE PASS REGION

Values (except pH) in parts per million

Column A: From soil beneath snowbank. Column B: From Snoqualmie River.

	A	*B*		*A*	*B*
Color	None	None	$(FeAl)_2O_3$	3.2	4.2
Odor	None	None	CaO	5.5	5.7
Turbidity	None	Slight cloudiness	MgO	Trace	Trace
			Na_2O	0.5	8.0
*p*H	5.91	7.08	SO_3	None	4.0
Total solids	34.9	32.2	Cl	3.0	2.0
Volatile solids	6.4	None	CO_3	None	None
Ash	28.5	32.2	HCO_3	15.2	29.2
SiO_2	10.2	11.2	CO_2	9.3	1.0

Since solubility continues down to the freezing point, water that passes through a snowbank, where it acquires carbon dioxide, into the soil should be able to do some work of solution. That it does is shown by the presence of rock minerals in solution in the meltwater from snowdrifts. In the Cascades, as in the San Gabriel Mountains, this proved to be the case. One sample of

[3] F. W. Clarke: The Data of Geochemistry, *U. S. Geol. Survey Bull. 330,* 1908, p. 87.

[4] The experiment was conducted by R. W. Moulton, associate professor of chemical engineering, University of Washington, and was reported in a letter dated December 12, 1947.

[5] *Ibid.*

water was taken from a foot of soil beneath a snowbank 12 feet deep at Snoqualmie Pass, and another from the Snoqualmie River a thousand feet below, where there would be a mingling of meltwaters from various areas. Analyses are given in Table II.

Additional evidence of chemical weathering in the alpine regions of the Cascades is furnished by the presence of soluble plant foods in the B horizon of the soil in sufficient quantities to support a dense growth of grass and flowers. Concentration of such chemical weathering in the nivation depressions is suggested by the fact that they often contain good soil.

It appears, then, that chemical weathering, especially that caused by the presence of carbonic acid, can take place under a snow cover. Such weathering will accomplish the greatest results under the deepest drifts, where the snow remains for the longest time, and it must, therefore, contribute to the formation of nivation depressions under these drifts. As a result it must contribute also to the development of asymmetry of mountain ridges where prevailing winds, transverse to these ridges, cause unequal accumulation of snow on opposite slopes.

GLACIOLOGICAL RESEARCH ON THE NORTH ATLANTIC COASTS: A REVIEW*

GORDON MANLEY

THE publication of this first monograph in the Royal Geographical Society's new research series is an event of unusual interest. In presenting Professor Ahlmann's masterly review on the eve of his sixtieth birthday of the results of 30 years of productive geographical investigation the Society is to be congratulated on its choice. It has fulfilled thereby an objective that can be regarded as the modern counterpart of that of the sixteenth-century atlas maker, who by disseminating the results of exploration did so much to stimulate scientific inquiry in every direction. For, like the explorers of past days, Ahlmann has shown little propensity to spin words on what geography is; instead, he has repeatedly outlined new worlds to conquer. Such a demonstration of the functions of the geographer and his relationship to the peripheral sciences is welcome.

Ahlmann's work deserves the notice of many who have little or no interest in glaciers, but who are interested in defining the scope and aims of geographical studies. Geographers have a particular function in the exploration of a number of boundary layers in which changes occur, at which the interaction of events is at times neglected by the scientists who take for their province the realms on either hand.

Studies of the molding of the surface by glaciation in the Jotunheim led Ahlmann to field investigation of the behavior of glaciers themselves, for which much reconnoitering and large-scale out-of-door work demanding a massive display of energy and persistence was required, together with the ability to interpret widespread field evidence before the finer tools of the physicist might justifiably be brought forward. Field measurements on the Styggedal Glacier led gradually to the recognition of the primary dependence of glacier behavior on temperature, especially during the ablation season; but the questions immediately arose whether air temperature was the dominant factor elsewhere—in regions of greater precipitation, for example—and what parts were played in different climates by radiation, evaporation, and advection of moist air with regard to the ablation loss from the glacier surface. Expeditions to Spitsbergen, Iceland, and Northeast Greenland followed, and investigations have continued on the Swedish glaciers. In Spitsbergen extensive studies of the radiation income were made. It also became evident that the convection loss from glacier surfaces bears a complex relationship, difficult of solution, to wind speed. Questions of surface turbulence and the eddy transfer of heat at once arose; these were attacked by Sverdrup, who in 1934 accompanied Ahlmann to Spitsbergen as joint leader, and we may recall that he has now proceeded to tackle the larger problem of exchange of heat between ocean and atmosphere.

Throughout, as Ahlmann says, the field researches have been allowed to grow unmarred by a preconceived plan; hence by-products abound. From stormy Vatnajökull, Ahlmann, with Eythórsson as joint leader, satisfied us concerning the relative importance of

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* Hans W:son Ahlmann: Glaciological Research on the North Atlantic Coasts. 83 pp.; maps, diagrs., index. *Royal Geogr. Soc. Research Ser. No. 1*, 1948. 7s. 6d.

➤ PROFESSOR MANLEY, geographer and climatologist, has been appointed to the newly established chair in geography at Bedford College, London.

temperature and precipitation with regard to glacier regimes. By means of careful measurements he has steadily reinforced and extended his preliminary conclusions, and he has not been afraid to recognize that too much stress must not be laid on the results from a single glacier in a single season. His younger colleagues Carl Mannerfelt of Sweden and Sigurdur Thorarinsson of Iceland have since come forward with extremely stimulating contributions of their own, whose significance is summarized here in masterly fashion.

These studies of glacier behavior have now led to far-reaching conclusions, necessitating extensive revision of our ideas on the postglacial fluctuations of climate, as soon as it became clear from the work of many Norwegian investigators that the greatest postglacial advance of Scandinavian glaciers culminated about 1745 and that a general recession has prevailed since about 1850. Thorarinsson's analyses of glacier behavior over the world have led to a reconsideration of ideas with regard to eustatic changes of sea level. Among other developments around the periphery of Ahlmann's work, Werenskiold has written on historical aspects and Faegri has linked up botanical and glaciological studies in historical time in Norway; Von Post, Iversen, and Godwin have contributed to the postglacial botanical evidence; and more recently Pennington has provided additional evidence of postglacial climatic correlation across the North Sea, with which the work of Movius and Farrington must be integrated. Moreover, these prospects of climatic correlation appear to be supported by the results of the investigations of the instrumental records in Scandinavia, Holland, and England covering the last two centuries. Ångström from the meteorological side has linked up the instrumental data from Stockholm with the Scandinavian glaciological researches. Across the Atlantic the late Dr. Matthes not only summarized much of the Scandinavian glaciological work; in subsequent papers he drew significant conclusions from the recent evidence of glacial recession in the Southern Hemisphere. Further studies of Alaskan glacier behavior are already in progress; in the 1930's Swedish scientists initiated similar work in Patagonia; and we now learn that a joint Norwegian-Swedish-British expedition is to embark for Norwegian Antarctica. In addition to contributions on the problem of glacier motion, Ahlmann's investigations have continued to disclose an extensive field of climatological study of the widest significance. Scandinavian, and now Dutch, British, Canadian, and American, meteorologists are increasingly exercised by the recent amelioration of climate evident around the North Atlantic, and possibly extending elsewhere. In northwestern Europe it largely takes the form of a rise in the winter mean temperatures. Not only is it of potential economic importance, shown by the Greenland fisheries as well as in agriculture, but the questions arise how far it is developing in North America, whether the characteristics of the Beaufort Sea impose a lag between the warming of northwestern Europe and that, for example, of northwestern Canada, and to what causes such events may be ascribed. Elucidation of the factors governing coastal glaciation around the North Atlantic opens up many oceanographical questions of the greatest interest to all the countries bordering that ocean, especially with regard to the role played by water of Arctic origin.

Even in the realm of glaciological study numerous questions continue to crop up. For example, granted that near the coast of Northeast Greenland maritime influences are still important, and that above 7000 feet in high polar latitudes ablation is solely conditioned by radiation, at what latitude southward and at what height must we begin to allow for convection loss on the icecap? What happens in the transition zone between Clavering Island, with its 100 millimeters or less of precipitation, and extreme southeast Greenland,

with an excessively heavy precipitation, where glacier behavior might well resemble that of the Vatnajökull? What part was played by climatological factors in determining the thickness of the ice crossing the Shickshocks?

Indeed, the endless problems of the greatest climatic change of all, that of the Pleistocene Ice Age, so significant with regard to our own evolution, are beginning to be elucidated, not merely from the study of the rocks but from that of the existing glaciers. To this elucidation a long line of scientists around the Atlantic have contributed. Professor Hobbs's early contributions are gratefully remembered, as are those of Wright and Priestley, Mercanton, and their many predecessors. But it is doubtful whether any other living geographer has done as much to open up new fields of endeavor as Professor Ahlmann has. For the questions he and his colleagues pose continue to grow in number, however many the questions he and his many associates have answered. In that, in the reviewer's opinion, lies the attraction of their accomplishment: criticism of detail would be out of place, in face of the stimulus Ahlmann has given. In his hands geography is alive; his inspiring example shows that the geographer may go forward, confident that he is opening new ground for the physicist, the meteorologist, the oceanographer, and many more, not forgetting the biological scientist. Marginal phenomena of every kind both physical and human still abound, and it is a proper function for the geographer to continue to map not merely their locations and state but also their variations.

All geographers are indebted to Professor Ahlmann for this distillation in ten succinct chapters. When we remember that many of the contributory papers involve such a mass of careful detail resulting from magnificently organized field work that they run to two hundred pages of the *Geografiska Annaler,* we may well salute the Scandinavian accomplishment. Nor should we forget that, like a true geographer, Ahlmann has an eye for the world as a whole, shown by the cultural-geographical studies of Libya with which he has diversified a distinguished career.

This reviewer hopes that many students will be led to read the original papers, from which they will not only appreciate the need for active field work but will also realize that even a small field investigation may build up into a structure of consequence, often in unexpected directions. They will see the value of collaboration with the more specialized sciences and with workers in other countries. This epitome of Scandinavian glaciological studies should prove an especial inspiration to the younger university men of North America, who have both the challenging grandeur of a continent and the magnificent tradition of physical geography stemming from Maury, Gilbert, Powell, Coleman, and Davis, to mention but a few.

In a war-torn world the splendor of Nature's processes remains to remind man of his properly small part therein, both in time and in space; international cooperation is needed for their investigation, and the cheerful fling and rebound of ideas from coast to coast. For around the North Atlantic the extent of the ice is ultimately far more significant than a few peevish politicians with such playthings as bombs; and it is better to venture forth and discover than to sit like the sixth-century monks on the last manuscript in the last library. From northern Alaska to the Himalayas and Kerguelen, or even the Catskills and northwestern Scotland, work is waiting to be done. Professor Ahlmann's monograph is indeed opportune; he and the Royal Geographical Society are to be thanked for a compact, enlivening, and constructive publication. *Salve boreale lumen!*

THE CHANGING FACE OF RURAL MEXICO*

A REVIEW

HENRY S. STERLING

THE accelerated tempo of change in some aspects of Mexican rural life, especially those most affected by the agrarian revolution, has made it difficult for the interested observer to keep pace with developments. With protean facility the shape of rural land tenure, settlement, and agricultural land use has altered from one year or decade to the next, quickly outdating the careful observations of such American students as McBride, Gruening, Tannenbaum, and E. N. Simpson. Most of the English-reading public have had little access to an imposing array of recently published works by Mexican students of rural problems, of which perhaps the greater number have dealt with the difficult and controversial issues raised by the land-reform program.[1]

For these reasons, "Rural Mexico" by Nathan L. Whetten, professor of rural sociology at the University of Connecticut, is a valuable addition to the literature. The book is the outgrowth of three years of field investigation, from 1942 to 1945, sponsored by the United States Department of State and the Office of Foreign Agricultural Relations; it presents much fresh material and several new topics and reflects the author's ability—not universal among his predecessors in this field—to analyze and discuss complex and often controversial situations concisely and objectively. Although each of his broad topics—population, the agrarian problem, living standards, and social-political institutions—has been dealt with repeatedly elsewhere, both in English and in Spanish, Whetten is the first scholarly writer in more than a decade to weave them into a single, up-to-date fabric. The present reviewer has devoted particular attention to the first two, which have seemed to call most urgently for a new appraisal.

POPULATION GROWTH AND MOBILITY

Whetten finds that Mexico's rate of population increase, long among the slower ones in Latin America, has now become one of the most rapid. The excess of births over deaths in 1942 was 22.8 per thousand, twice that of the United States, despite a death rate also twice as high. The estimated population of 22 million on June 30, 1945, was about one-third larger than the population recorded in the 1930 census, an increase attributable only in small part to the repatriation of Mexicans during the depression of the early thirties or to more comprehensive enumeration in the 1940 census. The most significant implication of this increase is that Mexico's attempts to improve the status of the mass of the rural population must constantly be expanded to keep pace with its rapid growth; the program

* Nathan L. Whetten: Rural Mexico. xxv and 671 pp.; maps, diagrs., ills., bibliogr., index. The University of Chicago Press, Chicago, 1948. $10.00.

[1] Among the more mature and objective recent papers by veteran specialists in this particular field are: Ramón Fernández y Fernández: Logros positivos de la reforma agraria mexicana, *El Trimestre Económico*, Vol. 13, 1946, pp. 221–248; *idem:* Problemas creados por la reforma agraria de México, *ibid.*, pp. 463–494; M. A. Durán: Del agrarismo a la revolución agrícola, *Problemas Económico-Agrícolas de México*, Vol. 2, 1946, pp. 3–82.

➤DR. STERLING, associate professor of geography at the University of Wisconsin, specializes in Latin America. He has spent several field seasons studying the agrarian reforms in east central Mexico.

of land redistribution, education, improved agricultural techniques, and so on is already proving inadequate, in spite of maximum use of the government's rather meager resources.

The author refers only indirectly to the extensive internal migration that has been taking place among the rural population in the last four decades. A marked rural-urban movement has been supplemented by much drifting from one rural community or district to another, which is largely not reflected in available statistics because it did not cross state lines. This has been part of the fluid search for land, better opportunities, or greater security induced by the Mexican Revolution. The 1940 census revealed that almost 21 per cent of the population of the small central state of Morelos (one of several more extreme examples) had been born in some other state.

Problems Arising from the Ejidal Program

In dealing with agrarian aspects of Mexico, the author concentrates most of his attention on the *ejido*, which he defines as "an agrarian community which has received and continues to hold land in accordance with the agrarian laws growing out of the Revolution of 1910." Usually created by expropriation of hacienda land, and attached to an existing village, the ejido has attained a conspicuous position in the rural economy. Almost a quarter of all land in farms and about half of all cultivated land had been carved by 1945 into nearly 15,000 ejidos, with an aggregate population of about five million, or more than a third of all rural dwellers. Numerically, *ejidatarios* (individual ejidal farmers) comprised almost three-fifths of all rural landholders, and more than two-fifths of all persons gainfully employed in agriculture.

Obviously so far-reaching a change-over must have had drastic effects and drastic critics. The author discusses objectively some of the more frequently criticized aspects of the land-distribution program, two of which the reviewer would like to emphasize as of fundamental importance in their effect on the rural economy. One of these is the almost complete destruction, at least in the more productive parts of Mexico, of the hacienda as a large-scale unit of farm management. Not only was the hacienda in many instances—and for certain crops and types of land—a more efficient medium of agricultural utilization than the ejido, which has partly replaced it, but land was transferred from hacienda to ejido much faster than the ejidatarios could be financed, equipped, and taught to use it effectively. The second fundamental drawback has been the failure to determine and provide the amount of land needed for the support of an ejidal family, under various conditions of climate, soil, and land use.

The resultant overfragmentation of former hacienda land has created a rural proletariat of part-time farmers, most of whom can derive neither complete subsistence nor full-time employment from their tiny holdings, because of the inadequate amount and generally poor quality of arable land and the primitive methods and equipment. The average amount of cultivable land per active ejidal farmer ranged in 1940 from two hectares to a little more than four in the most densely crowded east-central states. The national average was less than six. Small wonder that many ejidatarios must find work outside the ejido, to the extent that in two-thirds of the states the amount of time spent in such work averaged in 1940 from a fifth to more than a half of all the workdays in the year. The situation will steadily deteriorate as the ejidal population increases.

Theoretically, there are but three possible outlets for the growing surplus population in the already greatly overcrowded ejidos: (1) to enlarge and multiply individual ejidal

landholdings; or (2) to increase the yield and income derived from them; or (3) to find new means of livelihood for the excess who have too little land or none at all. Unfortunately, little or no additional land is now available in the vicinity of most ejidos for the enlargement of holdings. Nor is there much hope of increasing the low ejidal output fast enough to provide for the constantly growing population, even at present low standards of living. The future looks dark indeed unless increased supplementary means of livelihood can be found. Those already in use, to an extent insufficient to meet the need, include part-time or full-time work as common day laborers in the vicinity of the ejido (still the principal outlet, from which the revolution was intended to rescue the ejidatario); rental or sharecropping of near-by private land (this reviewer has even seen cases of ejidal *purchase* of private farms); movement as seasonal migratory workers from one region to another or to the United States; exploitation of forest products; further development of rural handicrafts; and migration to the cities to swell the growing industrial labor force (the most promising in the author's opinion).

Whetten does not include among these partial remedies one to which government officials are giving much thought, namely permanent resettlement of surplus ejido farmers in peripheral districts such as the Gulf coastal lowland, which are still underpopulated in proportion to their potential carrying capacity. Basically, Mexico's rural land problem is partly one of maldistribution of population. It can never be completely solved *in situ* in the more densely populated parts of the country, where no matter how it is sliced there simply is not enough land to go round. Ejidal recolonization on an adequate scale would be a drastic, long-term, costly process, very different from several earlier, small-scale programs of establishing new colonies of small private farmers who had to pay for their land and finance at least the beginning of their farm operations.

One of the chief reasons for the failure of the ejido to get higher yields out of its present land has been the government's inability to provide credit and equipment to more than a small proportion of all ejidal farmers. Whetten advances two main reasons why so small a percentage (about 14 per cent) of all ejidatarios receive financial aid through the National Ejidal Credit Bank, which handles the bulk of the load. Most ejidos are unable for one reason or another to produce beyond their bare subsistence needs and thus have no surplus with which to repay loans. Further, in about 95 per cent of all ejidos the ejidatarios operate their tiny parcels individually instead of collectively, a practice that not only vastly impairs their efficiency but increases the difficulty of obtaining loans. For these sound business reasons the Ejido Bank allocated almost three-quarters of its loans in 1944 to a few relatively efficient collectives in the north and northern Pacific areas, worked by only about a quarter of Mexico's ejidatarios, whereas the crowded central states, with half of the country's ejidatarios, received only about 8 per cent of all loans.

Most of the other relative advantages of the collective system are simply those of large-scale operation, which the former hacienda enjoyed to some degree and the individually operated ejido has lost. The somewhat greater efficiency and prosperity that these tend to give to the collective are jeopardized by two serious disadvantages inherent in its more democratic setup, from which the hacienda did not usually suffer. These are the difficulty of obtaining good local management and that of maintaining discipline among a group of highly individualistic members. They lead the author to the unexpected conclusion—for which he has not prepared the reader, and of which this reviewer has found little evidence in east-central Mexico—that the trend is toward the breakup of the collective system.

In summing up, the author poses and seeks to answer three fundamental questions, as a measure of the success of Mexico's ejidal economy as a whole:

1. Are prevailing ejido crops different from those grown on private farms? Yes, for the most part, owing to the emphasis on subsistence crops in most individually operated ejidos.

2. Is ejidal crop production as efficient? No. Both crop and livestock yields are lower, in the latter case because of the ejido's disproportionately small share of the country's pasture (18 per cent in 1940) and livestock (23 per cent of all cattle for example,) and the poorer quality of both animals and methods.

3. What has been the over-all effect of the agrarian reforms on Mexico's agricultural output? Both the total livestock population and the output of most principal crops have increased since the period 1903–1907, by as much as 300 per cent or more in the case of rice, sugar cane, bananas, and certain lesser commodities. More significant, however, is the fact that not only has output of the chief basic food staples, corn, wheat, and beans, not kept pace with the growth of population (now about 45 per cent larger than in 1910) but production of corn and beans has actually decreased.

The Rise of the Small Private Farm

The only disappointing chapter in the book to this reviewer is the one on colonization and the development of the small private holding—chiefly because of what it leaves out. One of the most important results of the agrarian reforms has been the multiplication of small and medium-sized private farms, largely through voluntary subdivision and sale by hacienda owners of land threatened with, or spared by, expropriation. Whetten lists such farms as one of three main genetic types of new "small" farms; the others are the residual nucleuses of the haciendas themselves, reduced by expropriation and sale to small-property size, and new private farms created by minor colonization programs. Although the word "minor" is his, he devotes more than half of his chapter to this third type. Little is said about the distribution, problems, financing, or success of the main group of small private properties of various sizes, new and old, whose number and area increased about 45 and 24 per cent respectively in the decade from 1930 to 1940 alone.[2] The total of about 1,186,000 private farms of 200 hectares or less in 1940 amounted to more than two-fifths of all Mexican rural landholdings, including the ejidos.

Before we accuse the author of a dulled sense of proportion, it should be pointed out that his rather casual treatment of so important an element in Mexico's present rural economy reflects a corresponding unbalance in his source materials. The new small private property has received surprisingly little attention from recent students, either Mexican or English. This well exemplifies one of the methodological difficulties inherent in any reconnaissance study as comprehensive in content as this one, and covering so large and heterogeneous an area. Like some of the distinguished scholars who have preceded him, the author has tended to lean heavily, at times perhaps overheavily, on available statistics and other official sources and on published studies in general and has partly neglected certain important problems for whose adequate treatment he would have had to do extensive original field work. Confronted by a plethora of source materials on some topics and incomplete or contradictory evidence on others, he has been confined in important sections of his book to the

[2] The areal figure is based on data from the 1940 agricultural census, tabulated in Durán, *op. cit.*, p. 37.

role of compiler rather than synthesizer, unable wholly to screen out the inconsistencies and errors among his sources. He displays, therefore, particularly in his treatment of the agrarian problem, an obvious reluctance to venture out with assurance on the thin ice of inductive reasoning and synthesis, especially where this would have to be based in part on his own field observations, because of critical lacunae in the existing source materials. An author's criteria of topical coverage and emphasis may quite properly be determined largely by his own interests, as well as by the nature of his data. The reviewer can voice, therefore, only mild regret that although Whetten found time to study the much-studied Laguna program and the progress of certain small and atypical foreign and Sinarquista colonies, he could not spare a few days or weeks to examine so seemingly important and ubiquitous a theme as the status of the small private farmer.

A Challenging Educational Problem

After being impressed, in the first half of the book, by the outward metamorphosis of certain agrarian aspects of rural life, the reader is forcefully reminded in the second half, in Whetten's admirable treatment of living standards and social institutions, that most fundamental culture traits have undergone little change. Much of the persistent primitiveness of what he terms the "Indian-colonial" level of living—in which more than half of all Mexicans (more than three-quarters in much of the center and south) still exist after four centuries—is due more to cultural habit than to inadequate income. That is, the problem of raising standards of living, health, and agricultural techniques is to a high degree educational rather than economic, since many improvements in diet, housing, sanitation, and agriculture would cost little or nothing. Yet the thousands of shiny new schools one sees in rural villages and the recent campaign against illiteracy cannot solve the problem unaided. Most school children go no further than the first or second grade, and the thin veneer of new ideas there acquired rubs off quickly in the conservative family environment. Literacy in itself may be of dubious utility in many Indian communities. The rural priest, who could exert considerable influence in favor of improved living and agricultural practices, is generally apathetic if not hostile to the local educational efforts of schools and other government agencies. What is needed is a large-scale program of adult vocational guidance, which would gradually teach the masses of the rural population how to make more out of their meager resources. Although promising beginnings are being made, they seem pitiful in proportion to the size of the task—which grows, of course, as population increases. As long as the Mexican peasant remains culturally and economically isolated from the main stream of social and political consciousness of the nation, he will be liable to easy exploitation by such demagogic mass movements as *Sinarquismo* and by enterprising *políticos* who, in taking advantage of the ignorance and poverty of the rural population, seek to attain the ranks of the new *millonarios de la Revolución*.

Whetten makes it abundantly clear that it is far too soon to judge the success of the Mexican Revolution, which aims at nothing less than a wholesale reorientation of economic, cultural, and political ideals, to improve the welfare of the underprivileged masses. The closing of the immense gap between aims and accomplishment will call for many years of sustained effort and the solution of incredibly difficult problems. The author has done the Revolution—and its interested audience—a favor by focusing on some of its many facets the clear light of insight and objective appraisal, as perhaps only a wholly impartial outsider can do.

THE AMERICAN GEOGRAPHICAL SOCIETY

The November Lectures

The Society's lectures this season will comprise two series. Series A will consist of four lectures similar to those of former years. The first in this series was given at the meeting on November 16, 1948, at the auditorium of the Engineering Societies Building, 29 West 39th Street, Dr. John K. Wright, Director of the Society, in the chair. Mr. Murl Deusing, curator of education at the Milwaukee Public Museum, gave a most interesting lecture, "Safari in Africa," illustrated with colored motion pictures taken on the Central African Expedition of the American Museum of Natural History, which visited Kenya, Uganda, the Belgian Congo, and French Equatorial Africa in the winter of 1947. Included were views of a modern safari traveling by trucks, unusual scenes of the inhabitants of the areas visited, and striking pictures of the animal life, from elephants to ants and termites.

Series B will also consist of four lectures, less formal in nature, which will provide an opportunity for reports of recent field work and for the presentation of more technical and scientific subjects of geographical interest. Mr. Junius B. Bird, associate curator of archeology at the American Museum of Natural History, initiated this series on November 30, in Room 501 of the Engineering Societies Building, Mr. Woodfin L. Butte, a member of the Council, presiding. The subject of the lecture was "Problems in the Search for the Early Inhabitants of South America." Mr. Bird's abstract follows.

When Isaiah Bowman wrote that "one of the most impressive sights in South America is a tropical forest growing upon a glacial moraine," he was probably not thinking of its dismaying effect on the archeologist! For some years the American Museum of Natural History has sponsored archeological work in South America in search of the oldest cultures. By 1937 this had resulted in the recovery, near the Strait of Magellan, of human remains and artifacts of a people who hunted animals now extinct (Antiquity and Migrations of the Early Inhabitants of Patagonia, *Geogr. Rev.*, Vol. 28, 1938, pp. 250–275). More significant, in terms of the subsequent work farther north, was the evidence that the migrants who first reached the south end of the continent did so before the last major ice recession. This means, for one thing, that in Peru, where topography and climatic zones greatly restricted the possible migration routes of nomadic hunters, all aspects of postglacial change have to be considered. The spread of tropical forest into an area that should be prospected makes a difficult problem more complicated.

Recent field work along the Peruvian coast between Pacasmayo and Casma has yielded evidence on the changes that occurred there in the same period. Some artifacts that suggest nomadic hunters were found, but the search for these was curtailed in order to study the huge refuse deposits on the coast. These middens were started by the first people to farm the valley bottoms not long after a period of heavy alluvial discharge, perhaps connected with the last major ice retreat. The cultural level of these first farmers is of considerable interest. Subsistence was based on a combination of fishing, the gathering of wild plants, and the cultivation of squash, beans, gourds, calabashes, peppers, achira, and cotton. They did not have maize and pottery but did make many fabrics. This culture did not evolve from the earlier hunting stage; the stone tools of the farming fishermen indicate no knowledge of the earlier pressure flaking technique.

Whence these people came remains a mystery. Studies on the evolution of cotton may have some bearing (see the *Geographical Review*, Vol. 38, 1948, pp. 167–169).

Mr. Hitchcock's Trip to Argentina

Mr. Charles B. Hitchcock acted as a delegate for the United States and representative of the Society at the Fourth Pan American Consultation on Cartography of the Pan American Institute of Geography and History held in Buenos Aires from October 15 to November 3, 1948. Discussion groups comprised committees on geodesy, topographic maps and aerophotogrammetry, aeronautical charts, hydrography, special maps and charts, and urban surveys, and subcommittees on gravity and geomagnetism and on tides. After the meetings, the Argentine government conducted a field excursion to San Carlos de Bariloche in the Patagonian lake district and to the city of Mendoza. Before returning to the United States, Mr. Hitchcock took the opportunity to travel south as far as Ushuaia and visit the Italian colony recently established there.

A detailed report on the meeting will appear in a later number of the *Geographical Review*.

Studies in Medical Geography

The program of studies in medical geography described in the October, 1944, number of the *Geographical Review* (pp. 642–652) was formally inaugurated on November 15, 1948, when Dr. Jacques M. May took charge. Dr. May, a French surgeon, who has had an active career in Indochina, Siam, Equatorial Africa, and the Caribbean, is now resident in New York. He will set forth the order and character of the investigations to be pursued and enter personally upon some of them. Though some exploration has been carried out in the geographical aspects of medicine, never before has this been done in a geographical center and under geographical direction.

Distribution of Title Page, Contents, and Index of Volume 38 of the "Geographical Review"

The title page, table of contents, and index for Volume 38 of the *Geographical Review* (1948), issued separately, will shortly be ready for distribution. Copies are sent to all institutions exchanging publications with the Society and to individuals who request that their names be put on a list for this purpose.

GEOGRAPHICAL RECORD

NORTH AMERICA

FLUORSPAR RESOURCES OF NEWFOUNDLAND. The decision of Newfoundlanders as expressed by the referendum of last summer to join the Canadian Confederation and become the tenth province of Canada has led to some speculation as to probable changes in the island's economy. An over-all estimate of the situation is contained in an article in *Foreign Commerce Weekly* for October 9, 1948 ("Newfoundland's Union with Canada May Depress Exports to Island," Vol. 33, No. 2, pp. 3–6 and 47–48), in which the point is made that "Newfoundland has limited and specialized resources which have made its economy very vulnerable to changes in world trade." Salt fish and wood pulp are the two main items of export, but certain mineral resources, notably fluorspar, are also of interest (R. E. Van Alstine: Geology and Mineral Deposits of the St. Lawrence Area, Burin Peninsula, Newfoundland, *Newfoundland Geol. Survey Bull. No. 23,* 1948; Frederick Betz, Jr.: Geology and Mineral Deposits of Southern White Bay, *ibid., No. 24,* 1948).

The mining of fluorspar deposits in the St. Lawrence area was begun in 1932, and in the period 1933 to 1946 inclusive some 241,000 short tons were shipped, making the area one of the world's leading centers of fluorspar production (its present rank is fifth). The fluorspar occurs in veins filling fault fissures, principally in granite; vein thicknesses average four to five feet for the higher-grade deposits, 15 to 20 feet for those of lower grade. Mining is done by a form of shrinkage stoping, and a maximum depth of 350 feet has been reached "with no apparent decrease in the quality or quantity of the fluorspar." No reliable estimate of the extent of the deposits has been made, but it is felt that they are considerable, and that Newfoundland will continue to be an important producer for some time to come. Fluorspar has a variety of uses, but the greater part is taken by the steel industry (the electric-furnace process requires 14 pounds of fluorspar to a long ton of steel) and certain chemical industries.

TUCSON: SUNSHINE CITY. From the rough, tough, desert frontier town of the 1880's to the well-to-do, modern health and pleasure resort of today, the geographic factors involved in Tucson's development are ably interpreted by Margaret T. Parker in "Tucson: City of Sunshine" (*Econ. Geogr.,* Vol. 24, 1948, pp. 79–113). The city provides for its ten thousand or so winter visitors by means of numerous hotels, motor courts, apartment houses, guest ranches, hospitals, sanatoriums, rest homes, and private schools and counts its normal annual income from the influx at about seven million dollars. This, it may be noted, far exceeds the income derived from cattle and crop sales in the entire county.

Climate is, of course, the attraction featured by the resort business. During the "season" (November to April) nights are normally crisp or cold, middays sunny and warm, with mean daily maxima in the sixties and seventies. Low humidity and a high percentage of sunshine (the average is about 85 per cent of the total possible number of hours) make the climate particularly salutary for persons suffering from respiratory and rheumatic diseases. But Tucson offers other tourist attractions as well. Its setting in a mountain-rimmed basin is scenically fine; the striking desert flora and the magnificent sunsets add to its charm. Neighboring Indian settlements afford interesting excursions, and Mexico is only some 65

miles to the south. The city is also an educational center, and visitors take advantage of public lectures and concert series sponsored by the University of Arizona.

According to 1940 census figures, Tucson had a population of 35,752, but there is evidence of rapid growth during the war years; in 1946 the Chamber of Commerce estimate was 50,000.

SOUTH AMERICA

SOCIOECONOMIC STUDIES OF EASTERN BOLIVIA. Bolivia is generally accorded first rank among the Andean countries by commentators on the opportunities for agricultural development in the eastern border valleys of the Andes and the adjacent lowlands. Its zone of border valleys is broader, and its plains potentially suitable for grazing are larger. Moreover, it is generally recognized that the extension of roads and railroads into the region, whether down from the plateau or for outlet to the Paraguay River or the railroad system of Brazil, presents fewer construction difficulties than in any of the countries to the north (see R. R. Platt: Opportunities for Agricultural Colonization in the Eastern Border Valleys of the Andes, *in* Pioneer Settlement, *Amer. Geogr. Soc. Special Publ. No. 14,* 1932, pp. 80–107). In recent decades various schemes for colonization in the region have been advanced by government and private agencies, but for numerous reasons, notably the lack of transportation for marketable produce, most of them never got beyond the initial planning stage, and the few that did met, without exception, with early failure.

During World War II interest in the region was revived under auspices that at last offered some promise of results. Near the end of 1942 the Bolivian Development Corporation was set up as an autonomous entity of the Bolivian government by a tripartite contract signed by the government, the general manager of the corporation, and the Export-Import Bank of the United States, and funds were made available to it for road construction and a planning and organization program (see David Weeks: Bolivia's Agricultural Frontier, *Geogr. Rev.,* Vol. 36, 1946, pp. 546–567). In the following spring this corporation entered into an arrangement with the Bolivian Ministry of Agriculture and the United States Department of Agriculture for a program of agricultural research, and Dr. Olen E. Leonard, then social scientist for the Office of Foreign Agricultural Relations, United States Department of Agriculture, was placed in charge with the title Director of the Cooperative Agricultural Service Stations. Two of Dr. Leonard's reports have already been published, and three others are in preparation; the five are intended to afford representative coverage of all the broad agricultural regions of Bolivia. The published reports are "Canton Chullpas: A Socioeconomic Study in the Cochabamba Valley of Bolivia" (*U. S. Dept. of Agric., Office of Foreign Agric. Relations, Foreign Agric. Rept. No. 27,* 1948) and "Santa Cruz: Estudio económico social de una región" (Ministerio de Agricultura, Ganadería y Colonización, La Paz, 1948).

The Chullpas study deals with a small, closely settled valley of extremely small holdings worked chiefly by their mixed-blood owners and fairly intensively cultivated, though by the most primitive methods. The Santa Cruz study, on the other hand, deals with a region of plains or low relief east of the Andean border where the great landholdings of colonial and early postcolonial times still predominate almost exclusively, where the lines between the white hereditary owners and the mixed-blood cultivators are sharply drawn, where only an infinitesimal fraction of the land suitable for cultivation or grazing is utilized, and where

mechanized equipment, though it makes no appreciable difference in total production, is used in sufficient quantity to demonstrate its adaptability and value.

The high rate of natural population increase in both regions seems to support the contention of many students of Bolivian agricultural problems that the country's first need, when once a real advance has been made toward the solution of the transportation problem, is not foreign immigration so much as better distribution of its present agricultural population from overpopulated sections such as the Chullpas canton and a program of better land utilization and crop and livestock selection, training in more efficient methods of cultivation, and increased use of mechanized equipment in underpopulated sections such as that studied in Santa Cruz. The completion, hoped for in 1950, of the road now being built from Cochabamba to Santa Cruz by the Bolivian Development Corporation and of the railroad to Santa Cruz from Puerto Suárez on the Paraguay River, where it connects with the Brazilian railroad system, is certain to bring an influx of settlers into the Santa Cruz region (see the note in the *Geogr. Rev.*, Vol. 34, 1944, pp. 329–330). As the author emphasizes in his summary in both reports, whether the region will then contribute to the country's food supply what it is potentially capable of contributing will depend on the foresight and care with which plans for this anticipated influx are made and put into operation.

EUROPE

PLANNING FOR THE LAND OF BRITAIN. In "The Land of Britain: Its Use and Misuse" (Longmans, Green & Co., London [and New York], 1948) L. Dudley Stamp crowns his great and devoted work on the Land Utilisation Survey of Britain, begun in 1930. The greater part of this 500-page book is a history and summary of the survey, done with such skill that almost any part of it could be quoted for its intrinsic geographical interest. The tables and the 237 line illustrations are in themselves an epitome of the work. Here, however, we want to call attention to the larger aspects, the basic principles that emerge. First, the land is the nation's ultimate asset. Second, the physical characteristics of the land are permanent and broadly unalterable. "It is sometimes urged that modern scientific progress is such that man is able to overcome the disadvantages or difficulties of his environment, and that *any* land may be converted into first-class farmland. This is very far from the truth. The truth is that most land can be *upgraded* into a sphere of usefulness which is not inherent to it, but it can be upgraded only to a certain extent, depending upon the starting point which is the inherent character of the land." This statement, it may be added, is the more arresting because of the wartime experience behind it. But Britain, as Dr. Stamp pointed out long ago, could make more productive use of the land resources (Nationalism and Land Utilization in Britain, *Geogr. Rev.*, Vol. 27, 1937, pp. 1–18).

Land planning, says Dr. Stamp, is in essence the putting to optimum use of every acre of land in the country. It must be recognized, however, that circumstances change, and planning should be flexible and dynamic, with the criterion always the national advantage. Optimum use is also associated with multiple use. "Many parts of this country should, and indeed must, serve more than one use at the same time. . . . The whole countryside is a national asset to be used for the benefit, including the enjoyment, of all." Planning should take account of five basic needs. The order in which they are listed is interesting. First, the location of industry, the key to the whole; second, housing; third, food, the place of the farmer; fourth, recreation; fifth, communications; and to these is added use of the land for defense services.

AFRICA

METEOROLOGICAL SERVICES AND ANTI-LOCUST RESEARCH IN EAST AFRICA. The American Geographical Society has recently received various publications from the East African Meteorological Department. The Report for the period 1939–1947 summarizes events in a time when expansion was rapid, chiefly because of the war need of forecasting for aviation. Five, sometimes six, stations undertook twice-daily upper-air investigations; now the number is reduced to one, the central station at Nairobi (Eastleigh), where radiosonde observations are made. The territory covered by the service comprises Kenya, Tanganyika, Uganda, Zanzibar, and the Seychelles. The number of first-order stations (1947) is 9, of second-order stations 64, and there is the surprising total of 1283 rainfall stations (575 in Kenya, 408 in Tanganyika, and 278 in Uganda). Of special value is the list of "Mean and Extreme Values of Certain Meteorological Elements for Selected Stations in East Africa." There are 65 stations. The elements are (monthly and yearly means): mean temperature; mean maximum and minimum temperatures; absolute maximum and minimum temperatures (no exceptionally high temperatures are recorded; Mandera, in northeastern Kenya, is highest, with 104° F. in a seven-year period); relative humidity and cloudiness, morning and afternoon; rainfall (the general picture is of a not abundant rainfall: no mainland station has as much as 80 inches; Port Victoria, in the Seychelles, has 94 inches); days of rain (average number). Parenthetically it may be noted that an exceptionally heavy rainfall has been reported at Kisawasawa Mission in the Great Ruaha River basin (7° 51° S., 36′ 56′ E.), 18 inches falling in two days, December 24–26, 1947 (*Meteorol. Mag.*, Nov., 1948, p. 256).

The *Memoirs* include "Observations of Atmospheric Pressure in East Africa, Part 1, Results from First Order Stations" (Vol. 2, No. 1, 1948), by A. Walter. Mr. Walter was responsible for the founding of the British East African Meteorological Service and served as its director until his retirement in 1947. (Photographs of Mr. Walter may be seen in "Focus on Africa," *Amer. Geogr. Soc. Special Publ. No. 25*, 1941, Figs. 318 and 319.) The *Pamphlet Series* includes notes on the climate of British East Africa (divided into eight regions) and Nairobi Township, on forecast areas (based on uniformity of conditions; compare the contrast between varied Kenya and the vast stretch of "uniform" Tanganyika), and on weather at Entebbe and Kampala and at Dar es Salaam.

The Report states that "close liaison was maintained with the Anti-Locust Research Centre and the E. A. Anti-Locust Directorate." The statement is given significance in the Research Centre's *Anti-Locust Memoir 1*, "Seasonal Breeding and Migrations of the Desert Locust (*Schistocerca gregaria* Forskål) in Eastern Africa," by Z. Waloff, 1946. Two pertinent paragraphs may be quoted: "The seasonal trends of migrations and the changing location of breeding areas combine to produce a fairly regular pattern of seasonal distributions over East Africa. This regularity depends on the physiological responses of the locust to climatic factors, whose pattern changes from season to season in a regular manner, and is not due to migration or breeding cycles inherent in the species."

"Cartographical methods used in this study provided an objective means of grouping together a large number of disconnected records of breeding and flights of an active migrant insect, such as the Desert Locust in its swarming phase, and facilitated the analysis by revealing their seasonal regularities. These methods are generally applicable to the study of insect migrations."

Memoir 1 covers an area from the southern Anglo-Egyptian Sudan to northern Tanganyika. *Memoir 2*, "Migrations and Breeding of the Red Locust (*Nomadacris septemfasciata* Serville) in Africa, 1927–1945," by V. Morant, 1947, takes in the central and southern part of the continent. "Locust Control by Aircraft in Tanganyika" by D. L. Gunn and others (Anti-Locust Research Centre, London, and the Locust Control and Research Section, Department of Agriculture, Pretoria, 1948) describes a specific instance of collaboration between the services. This was an experimental spraying campaign against the red locust initiated at the suggestion of Dr. B. P. Uvarov at a conference of the International Red Locust Control Organisation held at Lusaka in June, 1947. The experiment was conducted in the Rukwa Valley region from August to November. Temperature, humidity, and winds—the most important factor in the spraying operations—are discussed.

A painstaking investigation in which observations were made of air temperature, humidity, body temperature (of the locusts), radiation, wind speed, and wind direction is described in "Behaviour of the Desert Locust . . . in Kenya in Relation to Aircraft Spraying" by D. L. Gunn and others (*Anti-Locust Bull. 3*, Anti-Locust Research Centre, London, 1948). But there is a long way to go before locust migration is understood. "The plain fact is that these gregarious locusts migrate in swarms and nothing is known of the causes."

A PLAN FOR NAIROBI. In 1896 the first white resident settled down at Nairobi, the "watering place" (Masai). Half a century later the municipal authorities bring out a handsome volume, "Nairobi: Master Plan for a Colonial Capital" (A Report Prepared for the Municipal Council of Nairobi, by L. W. Thornton White, L. Silberman, and P. R. Anderson, London, 1948). From its early days as a railroad town, Nairobi, on "the edge of a dusty plain with poor drainage and little water," has been in need of planning. Old problems are accentuated and new ones added now that the town has grown to a city of 100,000 inhabitants. Growth was stimulated during the war when Nairobi was headquarters for campaigns in and about the Middle East, and its influence still reaches beyond the bounds of the colony of which it is capital; it is headquarters for several East African institutions, among them the meteorological service (see above). But in planning it is especially the relation to Kenya as a whole that is considered. The revenue from a pioneer population is low, the costs of urban administration in Africa are high, and Kenya is "one of the poorer parts of the world." It is the old story. "The Malthusian problem is acute in Africa, where soils are open to great harm through over-cultivation and over-grazing and wrong burning, tilling and sowing methods. In a hilly country like Kenya's agricultural belt the land is threatened by rain and wind erosion. Pax Britannica, veterinary science, sedentary habits, famine relief, and protection from epidemics have raised density figures of occupation, or threaten to do so."

Nairobi has a mean annual rainfall of 40 inches, but it is seasonal and erratic (note the rainfall and evaporation graph), and the provision of an adequate water supply has long plagued the town council. Before a solution can be worked out, an idea must be had of the size and nature of the future population. The planners suggest 250,000 as "likely and desirable," with a composition roughly similar to the present one of Africans, Asiatics, and Europeans in the proportion 6 : 3 : 1. It is not proposed to extend the present area of 32.4 square miles, though there is insistence on carefully planned thoroughfares and tree planting.

In a review in the October, 1948, issue of *African Affairs*, Elspeth Huxley makes some interesting comments. "This recognition of the urban African as a permanent factor is recasting our ideas on the shape of African cities. Formerly, a town like Nairobi catered for

resident, well-to-do Europeans; for resident Asians at all income levels; and for a largely bachelor force of transient Africans, all of whom were assumed to have their real homes elsewhere. Now Africans are seen to be not merely resident but increasingly differential in incomes and therefore in housing needs, while Europeans can no longer be automatically placed in the economic upper class."

ATLAS OF TANGANYIKA TERRITORY. In the foreword to the "Atlas of the Tanganyika Territory" (Survey Division, Department of Lands and Mines, Dar es Salaam, 1942), written by H. P. Rowe, chief surveyor, director of civil aviation, and controller of aerodromes, Tanganyika, and dated December, 1942, he states: "Every endeavour has been made to arrange the format of this Atlas so as to present the historical, physiographical, economic and climatic factors in a simple form. It is appreciated, however, that additional information such as forest types, ornithology and bird migrations, etc., would add to the value of this publication but with the limited accurate knowledge available and the exigencies of the war it has not been possible to include such information; it is hoped to do so, however, in future editions."

In spite of its date, the Atlas, for security reasons, has not been made available to the general public but was distributed only to the various government departments of Tanganyika. [For editorial use a copy was kindly lent to the American Geographical Society by the British Information Services, New York City.—Edit. Note.]

As first produced, the Atlas consisted of 27 sheets plus a statistical section, a gazetteer, a foreword, and an index [i.e. table of contents]. In the "Physical Section" there are five sheets: a physiographical map, a physical map, a geological map, a map of average rainfall distribution with bar graphs showing seasonal distribution, and a sheet showing mean minimum and mean maximum temperatures, magnetic variation (at Dar es Salaam and Tabora), and isogonic lines.

Under "Biogeography" there are three maps: forest reserves, game distribution and game reserves, and a tsetse map. "Human Geography" is covered by a native population map, a European and Asiatic population map, a tribal map, a map of provinces and districts, a map of medical facilities, and one of educational facilities. "Industry and Commerce" has four maps: agriculture, cattle densities, minerals, and air, road, and rail communications.

Finally, there is a "Historical Section," with nine sheets. Sheet 19 contains eight reproductions of old maps, the "cartography of East Africa through the ages"; the first is Africa after Homer, 1000 B.C., and the eighth, Africa after John Ruysch, A.D. 1508. In addition to these and other old maps (1544–1805; there is also a map of part of East Africa, 1891), there are three (on one sheet) showing the sources of the Nile: after Sebastian Cabot, sixteenth century; according to geographers of the sixteenth and seventeenth centuries; and according to geographers in 1819. Two maps on one sheet show 50 years' development of Dar es Salaam—in 1891 and in 1941. Sheet 27 is a map of the routes taken by some of the European explorers, from Rebmann in 1848 to Baumann in 1895.

The Atlas is loose-leaf, and since 1942 two sheets have been added (1943): a map of hydrography and a provisional malaria map. A soil map and a vegetation map are now in preparation.

The Survey Division, Department of Lands and Mines, Tanganyika, hoped to complete the printing of the new edition of the Atlas by about December, 1948, but it will still remain for the Government Printer to effect the binding. It is hoped that the Atlas will be available

to the general public sometime in 1949. When it does appear, the Survey Division will have every reason to be proud of it; for it is well printed in color and well produced, and it contains much useful information assembled in one place instead of in a series of different publications, some not easily accessible.—P. J. GREENWAY

DEVELOPMENT OF SOUTHEASTERN RHODESIA. The problem of "a widening gap between food production and requirements" is evident in Southern Rhodesia as elsewhere. In the first nine months of 1947 this pioneer country imported more than 550,000 bags of maize from Argentina and the United States and some 220,000 bags of wheat from Australia. Not only has land development slowed down, but "unsound farming practices . . . have led to a deterioration of land fertility, lower crop yields, and serious soil erosion." One answer to the problem is the Sabi-Lundi development scheme (Sabi-Lundi Development: Interim Report [submitted by] Sir Alexander Gibb & Partners, Consulting Engineers, London [to the] Government of Southern Rhodesia, March, 1948. Investigations are being continued). The two rivers drain nearly a quarter of Southern Rhodesia. The altitude of the basin ranges from more than 6000 feet in the highlands north of Umtali to 1000 feet where the combined streams enter Portuguese East Africa. It is the area of the lower valleys, i.e. the land under 2000 feet, amounting to 9500 square miles, that is of prime interest to the scheme. Agriculturally the outstanding feature of this low veld is its dryness: rainfall is generally less than 20 inches, largely concentrated in the three months December to February, and is very erratic. The opinion is expressed that the climate is not unfavorable to white settlement—wet-bulb temperatures are compared with those of Brisbane—but risk from malaria, bilharziasis, and sleeping sickness is recognized. Summer or rainy-season crops include maize, millet, sunn hemp, groundnuts, sugar cane, and citrus fruits. Soils are generally suitable for irrigation, and with proper drainage the black basalt soils should be well suited to cotton. Irrigation could also be provided for some winter crops, such as wheat and lucerne. Preliminary estimates put the available water from the total catchment area of the Sabi at 72,000 million cubic feet a year, of the Lundi at 34,000 million cubic feet; the irrigable area is conservatively estimated at 500,000 acres. Three points considered of "major importance" are the putting of a large acreage under maize and wheat, the encouragement of mixed farming, and the "very strictest control" on cropping and on methods of cultivation to avoid erosion. It is of some interest to note that the native vegetation of the low veld is dense and profuse in spite of the low rainfall.

As a start, the report recommends the establishment of a pilot project of 30,000 acres, with a research station, on the bank of the Sabi. Recommendations are also made for dam and reservoir construction and hydroelectric development. This would be important in relation to industry and exploitation of mineral resources—the considerable deposits of apatite, for instance, if they should prove commercially workable. A preliminary survey of the mineral wealth of the basin—it already furnishes more than one-third of the mineral output of Southern Rhodesia—has been made by Sir Lewis Fermor, well known for his work in India. Coal, iron ore, and limestone occur in proximity, and secondary minerals include copper, tungsten, and chromium ores.

An adequate labor supply is essential to the scheme, and here there are some difficulties. The region is sparsely populated, and although some of the native reserves of Southern Rhodesia are overcrowded, it is not easy to persuade their inhabitants to move. As it is, the bulk of the labor supply comes from nonindigenous people.

THE DEATH OF LAKE CHAD. The Chad Basin is another example of destructive management of our resources. Erosion, deposition, and river capture are now at work jeopardizing the life of this relatively productive and densely populated area of French Equatorial Africa. In "La vie et la mort du Lac Tchad" (*Bull. Agronomique No. 3,* Ministère de la France d'Outre Mer, Direction de l'Agriculture, de l'Élevage et des Forêts, 1947) H. Jacques-Félix briefly outlines previous studies of the problem (see, in particular, the works by J. Tilho) and attempts to describe the probable evolution of the basin and formulate means of preventing its impoverishment.

Between the desert to the north and the zone of plentiful rainfall to the south, a fluctuating transition zone is being gradually "invaded" by the desert: vegetation is becoming poorer, water supply is decreasing. Eolian deposits are dropped by the harmattan from the north; from the south excessive quantities of material are being washed down the deforested and misused slopes and deposited in this alluvial zone. The level of the Logone River bed is constantly rising; at high water the river overflows and spreads out, and there is a consequent increased loss of water through evaporation. In addition, some of the former tributaries of the Logone are being diverted to easier paths. These waters fill the Eré Pogo depression and overflow into the drainage area of the Benue River, a tributary of the Niger. Moreover, the headwaters of the Benue are cutting through the watershed of the Chad Basin, the base level of which is 240 meters higher than that of the Niger. If the process continues unchecked, not only the Logone but the Shari also will be captured, and Lake Chad, deprived of its two main sources of supply, will dwindle to the vanishing point. To prevent or slow up capture, construction of dams is suggested. It is also recommended that present agricultural methods, which are accelerating erosion and filling, be changed and that activities be transferred from the drainage slopes to the alluvial zone.

DRYING RIVERS IN THE NORTHEASTERN TRANSVAAL. Extraordinary rainfall contrasts are created by the wall of the Great Escarpment in the northeastern Transvaal. Broederstroom Forestry Reserve, at 5200 feet, has an average annual rainfall of 80 inches; Tzaneen Estate, near the base of the escarpment, has 40 inches; 25 miles to the east the rainfall is 25 inches; westward on the plateau it drops to 25 inches in only 8 to 10 miles. The narrow, luxuriantly wooded strip of high rainfall acts as a reservoir for the waters draining across the arid low veld. Concern is expressed over the reduction of flow in many of these streams. T. W. Gevers of the University of the Witwatersrand has studied the progress of desiccation in the Letabas and other tributaries of the Olifants River, and he gives several case histories, based on evidence collected from old inhabitants and from documents of the Water Court in Duivelskloof, which furnished both general statements by riparian landowners and actual stream-flow measurements by civil engineers (Drying Rivers in the North-Eastern Transvaal, *South African Geogr. Journ.*, Vol. 30, 1948, pp. 17–44). He finds a general decrease in rainfall, marked since 1926, its effects intensified by despoilation of the vegetal cover and soil erosion. There has been an increase in the farming population, and some of the native reserves are overcrowded "and shockingly eroded." Whether the decrease in rainfall is cyclic or secular, harm is being done to the land by these contributory causes. To them must be added, in some cases at least, the introduction of eucalypts. The effect of this exotic is much debated and undoubtedly varies according to circumstances, but, says Dr. Gevers, "no elaborate measurements appear necessary when in every way comparable tributaries draining

opposite sides of a narrow and low dividing ridge are bone-dry on the side covered with dense gum plantations, and still running on the other side where the original bush, scrub and grass has been maintained," and he illustrates the situation with a striking aerial photograph.

AUSTRALIA AND OCEANIA

REGIONAL PLANNING FOR WATER SUPPLY IN WESTERN AUSTRALIA. Regional planning of any kind is relatively new in Australia; hence T. Langford-Smith's recent study in the technique of regional investigation as applied to water supply in the agricultural areas of Western Australia is worth noting as a pioneer venture in this direction (Water Supply in the Agricultural Areas of Western Australia, *Australian Geographer,* Vol. 5, No. 6, December, 1947, pp. 115–156). It is not, and does not purport to be, a comprehensive attack for the better ordering of the total resources of a region, nor does it contribute importantly to the methodology or philosophy of broadly conceived regional planning. Its purpose is to focus attention on a single set of problems—those relating to water supply—in a single region and to illustrate the techniques used during a specific investigation.

The region under discussion is the southwest "corner" of Western Australia, embracing 100,000 square miles of country receiving on the average and in the main 15 inches or more of rainfall a year. Agriculturally as well as geographically it may be considered a unit. A tripartite approach was used in the investigation, involving (1) a general study of the physical, economic, and social resources of the region, (2) a compilation of its history of development, and (3) a field investigation centering on amenities and social aspects. Stress is placed throughout on the vital role of water supply in any expansion of existing facilities or activities or development of new industries. The initial request for such an investigation came from the government of Western Australia, which also asked the Commonwealth to contribute half the estimated total cost (£10,000,000) of the Water Supply Scheme.

Included are brief descriptions of the outstanding features of climate, physiography, water, soils, salinity, minerals, vegetation, fisheries, land use, primary and secondary industries, power, transport, population and employment, amenities, and the growth of agricultural and pastoral settlement. There is a résumé of mistakes made in the past in the settlement and development of the wheat lands. Maps are used liberally to illustrate distribution patterns; two are of special interest. Map 5 utilizes unpublished data in a refinement of certain land-use-region boundaries; Map 7 defines three zones on the basis of need for domestic water supply. About 55 per cent of the Water Scheme Region already has adequate water for homes and domestic gardens (not stock), 25 per cent has enough for domestic use only, and 20 per cent has insufficient water for domestic use. Fifteen towns with populations ranging from 100 to 450 have no town water supply; most of them have a "very low" standard of living and hence are unable to finance supply schemes.

One difficulty encountered in the investigation was the adaptation of statistical units to conform even approximately with the Water Scheme Region, which may be reflected in certain minor inaccuracies or inconsistencies in the graphic summaries. And in a way it is unfortunate that the recommendations submitted as a result of the survey are not included in this purely factual report; instead, the reader is left to deduce the practical applications. In general, however, the report sheds further light on the pressing need for regional planning of water supply in water-deficient Western Australia.—ROBERT G. BOWMAN

POLAR REGIONS

GLACIER RECESSION IN JAN MAYEN. Professor H. W:son Ahlmann has termed glaciers "climatic recorders," and the late Dr. François E. Matthes wrote: "They [glaciers], more vividly than thermometers and snow gauges, tell us what is happening to the climate" (Foreword to "Report on the Palisade Glacier Survey," by W. F. Heald, on verso of "Palisade Glacier Map, Sierra Nevada, California," American Alpine Club Research Fund, New York [1947]). From this point of view Jan Mayen, with its 30 to 40 square miles of ice, ranging in elevation from sea level to the 7680 feet of the Beerenberg, is a strategic observation post. The island is some 600 miles from Norway and 300 miles from Greenland, 350 miles northeast of Iceland, and 600 miles southwest of Spitsbergen. It thus forms a link between temperate Iceland and Arctic Spitsbergen and between Greenland, which is still in its glacial age, and Scandinavia, where only relatively small glaciers exist. Of great potential value to future studies is the fact that a Norwegian Meteorological Observatory has been in operation on Jan Mayen since 1921.

The behavior of the terminal parts of the Jan Mayen glaciers, as observed by the Imperial College of Science Expedition in 1938, is discussed in an interesting and timely paper by J. N. Jennings, "Glacier Retreat in Jan Mayen" (*Journ. of Glaciology*, Vol. 1, No. 4, 1948, pp. 167–181).

Mr. Jennings reports that between 1882–1883, when the Austrian Polar Year Expedition made the first observations, and 1938 the termini of several glaciers receded several hundred yards—South Glacier retreated 780 yards—and the surface of the ice was also lowered appreciably. The three most vigorous glaciers, on the north side of the island, still discharge actively in tidewater and have apparently shrunk less than the others. Some of the smaller ice streams, East Weyprecht Glacier for example, are shrinking rapidly. "Since the East Weyprecht depends much more on the lower levels for its alimentation than its neighbours, any rise in the firn line would affect it more; and this might be registered in the retreat of the snout as was observed." Such a condition is in accordance with that observed in parts of Prince William Sound, Alaska, where several glaciers draining from high névés have advanced steadily in recent decades, whereas neighboring glaciers with sources in lower névés are in conspicuous retreat. Besides a rise in the firn line, it has been suggested that an upward shift of the level of maximum snowfall may also be responsible.

Jennings concludes that most of the glaciers of Jan Mayen have been shrinking in their lower parts since well before 1882. Descriptions in that year indicate that slow horizontal retreat and a considerable lowering of the terminal parts of the glaciers had already occurred. Since then, the rate of shrinking seems to have been accelerated. Sigurdur Thorarinsson (Present Glacier Shrinkage, and Eustatic Changes of Sea-Level, *Geografiska Annaler*, Vol. 22, 1940, pp. 131–159) suggests that the first phase of recession, mainly before 1882, may be correlated with the ice recession noted in Iceland and Norway after the maximum of about 1750, and that the second phase, mostly since 1882, may find its counterpart in the recession in Iceland and Norway which followed the advances of the middle and latter part of the nineteenth century. It is of interest to recall that important maxima were also established along parts of the Alaskan coast, notably in Glacier Bay and Yakutat Bay, about the middle of the eighteenth century, and that more recently the glaciers in that area which have their sources in relatively low-level névés have also been receding rapidly, and in some cases catastrophically.

PHYSICAL GEOGRAPHY

STUDIES OF RIVER ACTION. To the geomorphologist studying fluvial landforms and the engineer seeking to control rivers, an understanding of the concept of the graded river is of fundamental importance. Both, therefore, will welcome J. Hoover Mackin's recent analysis of this concept (Concept of the Graded River, *Bull. Geol. Soc. of America,* Vol. 59, 1948, pp. 463–511). A graded stream is a system in equilibrium, "in which, over a period of years, slope is delicately adjusted to provide, with available discharge and with prevailing channel characteristics, just the velocity required for the transportation of the load supplied from the drainage basin." If there is a change in any of the controlling factors, the graded stream, like any other system in equilibrium, reacts at once in such a way as to re-establish equilibrium. Such responses to man-made changes in condition are sometimes very rapid. The Elephant Butte Reservoir on the Rio Grande, for example, has caused changes in stream slope both upstream and downstream. Because of the settling of debris in the reservoir, the river below the dam has a reduced load and has begun to cut its channel down to a lower gradient. On the upstream side, however, the delta built into the reservoir has flattened the gradient of the stream. Since the completion of the reservoir in 1916, the aggradation near its head has raised the channel of the Rio Grande at least 10 feet. It is chiefly by such changes in slope that a graded stream adjusts itself to changes in discharge or load. Adjustments made by modifications of the channel characteristics—roughness, alignment, and cross-sectional form—are apparently of minor importance.

Because discharge, load, and channel conditions vary along the length of the stream, the steepness of slope that will provide the energy needed for transportation of the load also varies. Usually it decreases in a downvalley direction, in response to downvalley increase in discharge, decrease in load relative to discharge, and decrease in caliber of load caused by attrition. Such downvalley changes in conditions are not systematic, however, and the graded profile is therefore not a simple mathematical curve. This is well illustrated in a recent publication of the Mississippi River Commission (Harold N. Fisk: Fine-Grained Alluvial Deposits and Their Effects on Mississippi River Activity, 2 vols., U. S. War Department, Corps of Engineers, 1947). The longitudinal profile of the Mississippi River as shown in Plate 1 has a gradual downvalley decrease in slope. "However, the valley slope is not regular but consists of a series of long flat steps separated by shorter, slightly steeper risers in areas where the alluvial plains of major tributaries join the flatter lowlands, as near the mouths of the Arkansas and Red Rivers."

In this and earlier publications the Mississippi River Commission reports that the Mississippi as a whole is neither aggrading nor degrading its channel. This condition of equilibrium the commission describes as "poised" rather than "graded," though apparently the two terms mean approximately the same thing. When volume, slope, and load are more or less constant, as they are for the poised Mississippi, the nature of the bed and bank materials becomes an important factor affecting stream activity. Because fine-grained materials are more cohesive and less permeable than sands, riverbanks made of the former recede more slowly than sand banks and can stand with steeper subaqueous slopes. When they do, intermittently, cave in, it is by slumping of extensive blocks, which produces an irregular, scalloped shore line. Sand banks, on the other hand, recede by the instantaneous, more nearly continuous, and rapid response of sloughing and have smoother shore lines. Retarded channel migration in fine materials is accompanied by deepening and narrowing

and greater asymmetry of the channel cross section. In sandy deposits the channel is wider, shallower, and more symmetrical.

The northern and southern parts of the Mississippi Valley illustrate these differences in stream behavior. "In the southern part of the valley, where the topstratum of fine-grained deposits extends to or below the depth of channel scouring, it is difficult for the river to remove sufficient material to cause slumping. In these areas migration is slow and the channel is deep and narrow," as is shown by cross sections on Plates 60, 61, and 62. These plates, and Plate 1, a generalized longitudinal profile, show also the great depth to which river scouring extends in this area, reaching a maximum of about 200 feet below sea level. However, "in the northern part of the valley where the topstratum is comparatively thin, bank caving . . . is almost continuous, migration is consequently rapid, and the channel is relatively wide and shallow." In this northern part, local fine-grained deposits, the fillings of abandoned parts of the river channel, are important for their influence on the growth and migration of meander loops and the formation of reaches. "By locally hindering migration of the meander loop arms, and by controlling local stream alignment, these resistant bank deposits have altered the shape of the loops and have been directly responsible for their being cut off from the river." Reaches, or straight stretches of the river, often develop downstream from places where the river is kept from migrating, either by local fine deposits or by the more resistant rock of the valley wall.—ANASTASIA VAN BURKALOW

OBITUARY

FRANÇOIS EMILE MATTHES. Friends and colleagues of François Emile Matthes were deeply grieved to learn of his death, on June 21, 1948, at El Cerrito, Calif., where, since his retirement from the United States Geological Survey in 1947 after 51 years of distinguished service, he had resided in the shadow of the mountains he loved so well.

Mr. Matthes was born in Amsterdam, The Netherlands, on March 16, 1874, and came to the United States in 1891. Here he entered the Massachusetts Institute of Technology. On becoming a naturalized citizen in 1896, he joined the Topographic Branch of the Geological Survey. The superb artistry and thorough understanding of landforms displayed in his delineation of terrain by the contour line led to the production of maps of such difficult and spectacular areas as the Big Horn Mountains, that part of the Rocky Mountains which is now Glacier National Park, the Grand Canyon of the Colorado, the Yosemite Valley, and Mount Rainier National Park. His studies of glaciation and the processes of high altitudes resulted in the first of his many publications, "Glacial Sculpture of the Bighorn Mountains, Wyoming" (*U. S. Geol. Survey, 21st Ann. Rept., 1899–1900*, Part 2, 1900, pp. 167–190), in which he named the process of "nivation."

Because of his ever increasing interest in the origin of landforms and glaciers, Mr. Matthes transferred in 1914 to the Geologic Branch of the Geological Survey, with which he was to be associated until his retirement. During both World Wars he was consultant for the Army and Air Forces. His long record of professional achievements is typified by that classic of modern geological papers "Geologic History of the Yosemite Valley" (*U. S. Geol. Survey Professional Paper 160*, 1930).

Interest in glaciers and their sculpture of the land and the recognition of the recent re-establishment of glaciers in the mountains of the western United States, named by him the "little ice age" (Glaciers, *in* Hydrology [Physics of the Earth, Vol. 9], New York and

London, 1942, pp. 149–219), led directly into the fields of climatology and meteorology. At the time of his death he was engaged in completing a critical analysis of the glacial anticyclone theory. Unfortunately, only Part 1 has been published, "The Glacial Anticyclone Theory Examined in the Light of Recent Meteorological Data from Greenland" (*Trans. Amer. Geophys. Union,* Vol. 27, 1946, pp. 324–341). Since 1931 Mr. Matthes had been chairman of the Committee on Glaciers of the Section of Hydrology of the American Geophysical Union, charged with collecting the results of studies and measurements of modern glaciers and their fluctuations throughout the world. At the time of his death he was also secretary of the Commission of Snow and Glaciers of the International Association of Scientific Hydrology, International Union of Geodesy and Geophysics. He served as president of the Geological Society of Washington in 1932 and of the Association of American Geographers in 1933; the subject of his official address to the latter was "Our Greatest Mountain Range, the Sierra Nevada of California."

Mr. Matthes' professional career was enriched by his efforts to bring to the layman an appreciation and understanding of the beauty and development of the landscape. His kindly wisdom and readiness to aid both amateur and professional endeared him to all. In 1947, when he received an honorary LL.D. degree from the University of California, President Sproul said: "By your artistry in the delineation of landforms and your clear, scientific description, you have interpreted the beauty of the Western American landscape to the mind, as well as the eyes, of all who love the mountains." Shortly before his death he was presented with a gold medal by the Department of the Interior for his long and distinguished service to the government. The honor that he prized most highly, however, was the "Order of the Silver Beaver," conferred upon him by the Council of the Boy Scouts of America for "distinguished service to boyhood."

To his colleagues and his many personal friends throughout the world, the passing of François Emile Matthes is a great loss. His understanding and appreciation of, and devotion to, the beauty and orderliness of the natural landscape endure in his published works, to be shared by all.—Louis L. Ray

GEOGRAPHICAL NEWS

THE SIXTEENTH INTERNATIONAL GEOGRAPHICAL CONGRESS. The postponed meeting of the International Geographical Union (see the *Geogr. Rev.*, Vol. 38, 1948, p. 156) is now scheduled to be held in Lisbon in the spring. The dates of the meetings are April 8–15, and the excursions to follow will occupy about another week. It is hoped that there will be a good representation of American geographers. Those planning to attend are asked to communicate with Professor George B. Cressey, Syracuse University, who is chairman of the United States National Committee.

MEXICAN NATURAL RESOURCES—THEIR PAST, PRESENT AND FUTURE. By WILLIAM VOGT. Ills. *In* Report on Activities of the Conservation Section, Division of Agricultural Cooperation, Pan American Union (1943–1946), Washington, D. C., 1946, pp. 28–87. See also "Bibliography on Conservation Problems in Mexico," *ibid.*, pp. 88–111. (A Spanish version, "Los recursos naturales de México: Su pasado, presente y futuro," was published in the "Memoria" of the Segundo Congreso Mexicana de Ciencias Sociales, Vol. 2, 1946.)

PRELIMINARY SURVEY OF CONSERVATION POSSIBILITIES IN EL SALVADOR. By W. CLINTON BOURNE, THOMAS W. MCKINLEY, CARL P. STEVENS, and MARIO PACHECO [constituting the Field Party of the Division of Health and Sanitation, Institute of Inter-American Affairs.] xiii and 167 pp.; maps, diagrs., ills., bibliogr. Servicio Cooperativo Interamericano de Salud Pública, El Salvador [1946?]. 9¾ x 7 inches.

THE POPULATION OF EL SALVADOR AND ITS NATURAL RESOURCES. By WILLIAM VOGT. 30 pp.; diagr., ills. THE POPULATION OF COSTA RICA AND ITS NATURAL RESOURCES. By WILLIAM VOGT. 25 pp.; ills. THE POPULATION OF VENEZUELA AND ITS NATURAL RESOURCES. By WILLIAM VOGT. 52 pp.; ills. Pan American Union, Washington, D. C., 1946. 10½ x 8¼ inches. (Also published in Spanish.)

A few years ago the Pan American Union undertook the highly practical, if difficult, task of developing a conservation section in the Division of Agricultural Cooperation; in charge of this new section it put Mr. William Vogt—an excellent choice.

Mr. Vogt is a realist. In his report on the activities of the Conservation Section, 1943–1946, he gives a most intelligent description of Mexican land resources, their destructive use, and the terrifyingly slight prospect of comfortable existence in Mexico unless there are great changes in management of the land.

Mexico is rich in some of the metals, but poor in fuel, so poor that fine saw logs are made into charcoal to feed the little fires which cook the omnipresent corncakes; yet lumber is scarce. Mexico is poor in agricultural land from which man must be fed. There are mountains, mountains, beautiful mountains; deserts, deserts, beautiful deserts; drenched tropical lowlands with all the limitations that beset wet tropical lowlands. There is also a small amount of possible cropland, so small indeed that in a recent year the total production of grain of all sorts was 280 pounds per capita. In the United States it was 2200 pounds, and on the average we ate 240 pounds of wheat.

Mexico is already overpopulated. To make it worse, there is the appalling increase—15.8 per cent, 1940–1946 (*Statesman's Year-Book*, 1948). The pressure is acute, and the people are pushing up onto the steep land with their milpa system of corn growing. "In Mexico I [Vogt] have repeatedly seen corn-fields on slopes approaching 100%" (i.e. 45°). In such a situation people regard it as but natural that they should move into a national park of forest and grass and there cut timber, plant corn and overpasture, and let forest fires run. Thus "the forested slopes of Bosencheve National Park, not long ago, would have fallen in Class VIII [forest land]—and had considerable importance as protection of watersheds, and a source of wildlife. Now, however, with their vegetation stripped away, they have lost much soil and are, over considerable areas, nearly as useless as desert land without water. Even level

lands, such as those below the eroded slopes of La Malinche, may be destroyed by hardpan and floods from above. They drop from Class I or II to Class IX [desert]."

Mr. Vogt summarizes: "It means, without any possibility of controversion, that a substantial proportion of the land at present under cultivation in Mexico—under cultivation without strip-cropping, terracing, etc.—*must be retired from cultivation.*

"The immediate and obvious objection will be: 'But what are people going to eat?'

"To this there can be only one reply: 'What are they going to eat when the soil has been destroyed? Would it not be better to utilize the land *permanently* in the way best suited to it, than to destroy its productivity completely within a decade?' "

The answer is, of course, "Yes," but, alas, man does not do it that way. When hunger bites us, we eat. It may blast the future, but we eat if we can. Hunger is an overpowering motive.

"One of the most eminent botanists in Mexico gives the State of Oaxaca a mere fifty years of survival. So generally is the Mexican land being degraded from productivity to near-desert conditions that—unless a radical change is made in land-use policies—it seems certain that within a hundred years most of the people of Mexico will be reduced to a mere subsistence level comparable to that of the Chinese peasant."

Operations carried out with good intentions do not always produce the expected results. I recall reading 15 or 20 years ago the reports of hookworm extermination and other tropical sanitation being carried out by The Rockefeller Foundation. Now the results are coming in: Mexican population is increasing at the rate given above, and in the search for food it is ripping the country to pieces. Is The Rockefeller Foundation willing to take the next step?

Mr. Vogt, as we have said, is a realist. Referring to the ancient concentrations of Aztec population he says: "Large centers of population concentrated on the Mexican plateau but, fortunately, the means was not at hand to reduce the death-rate and, thus, induce a pyramiding of the population. The word 'fortunately' is used advisedly. Had there not been some means of holding the population in check, Tenochititlán might have suffered the same fate as the Mayan cities to the south. I have never heard an ecological justification for the large-scale killings on the part of the Aztecs. But—though it may be difficult for us to appreciate today—such killing may have been a very sound biological mechanism."

If the situation of El Salvador were not so tragic, an admirer of "Alice's Adventures in Wonderland" might see a tinge of comedy in this really good report by the Institute of Inter-American Affairs. The President of El Salvador wrote concerning the plan: "It is understood that such a plan will be prepared at the expense of the Institute.

"On submission of such a plan to the Executive Power and with its proper consideration there will be every intention on its part to make adequate provision for its application for the benefit of El Salvador."

The report gives a lot of useful information to one who would understand El Salvador, and, like an American farm paper or forestry journal, it burgeons with fundamental wisdom, ages old—and widely disregarded in both the United States and El Salvador.

For example, to reforest, it says give the native plants a chance "under these provided conditions":

1. The recurrent annual burning of all dead vegetative material must be stopped.
2. All grazing must be withdrawn.
3. Limited lumbering may be permitted under conservative practices that clearly designate what, how, where and when any or a few trees may be cut.

4 Destructive operations for lumber, wood, or forest by-products, as rosin, tanbark, small poles, peeling live trees for bark for any purpose, cutting young trees or boughs, etc., must be promptly stopped.

That is typical of the good advice with which the book is filled. Will the Salvadorians take it? Can they? It has a certain resemblance to the famous "Let them eat cake."

The basic thing in the report is a graph showing population figures for El Salvador: 200,000 in 1807; 783,000 in 1900; 1,460,000 in 1930; 1,935,000 in 1945. We have here a result, a typical result, of the too little mentioned "sanitary revolution," which has cut the death rate while the birth rate keeps right on bringing hunger into a world of shrinking cropland.

The average food consumption of the Salvadorians is 1500 calories a day. If you want to know what that means, try it for six days and keep on with normal activities. As it is the Salvadorian *average*, the poorer people have less than that, and when the well-fed American gentlemen tell them to quit pasturing, quit chopping, quit plowing land with 75 per cent slope, what can the poor Salvadorians do? What do we do in this country? We are chopping wood 50 per cent faster than it grows and sending topsoil to the sea by billions of tons a year, and our situation is infinitely easier than that in which the Salvadorians find themselves.

Then there is the conservatism of the farmer, the ignorance of the illiterate, and the debility of the tropics, plus malnutrition. The report tells of izote, a thick-rooting plant introduced from Mexico "in remote times," which when close-set on the contour makes an almost perfect barricade against erosion and permits coffee to grow on a 75 per cent slope without appreciable erosion. "Its [izote's] use for controlling erosion in corn fields was suggested by the now inactive Instituto Tecnológico de El Salvador, but unfortunately it has not yet been tested for this purpose."

In some few places in the world overpopulation results in assiduous care of the land, but in most places the accompanying hunger drives to resource destruction, as in mountainous Latin America and in parts of China as observed by W. C. Lowdermilk and, independently, by this reviewer.

The Pan American Union's studies of El Salvador, Costa Rica, and Venezuela present the same land classification and fairly similar discussions of land use and stress the same acute need for restoration.

For those who do not have a personal acquaintance with these countries the most salient thing is the photographs. The destruction they show is almost unbelievable—Venezuelan wheat fields so steep that it would seem difficult to walk in them without falling off (Fig. 1).

The reports on El Salvador and Costa Rica have little to say about the people—they are concerned mostly with resources—and they need not be mentioned further to those who have read the above comments on El Salvador. The Venezuelan report is longer and contains a fairly complete description of the resources, economic status, and related culture. It is a tragic picture of a nation moving rapidly toward catastrophe, explosive catastrophe at that.

The 13 per cent of the area that is mountainous has 70 per cent of the population, most of them trying to grow their food on land that was never meant for farming except of the most scientific character. (Such land in Corsica and other Mediterranean regions supports a permanent agriculture of tree crops.) Most of the remainder of the country is llanos, vast plains of poor soil, largely so perhaps because of annual burning, which destroys the nitrogen and makes the potash water-soluble and ready to be carried away by the next heavy rain.

The trouble here and elsewhere in Latin America is made infinitely more serious by the

prevalence of corn and beans as the basic crops. "It is probable that throughout this entire [mountain] area not over two or three per cent of the land has a slope of less than 5%. . . . As a matter of fact, thousands and perhaps hundreds of thousands of hectares throughout the Andes are being cultivated on slopes in excess of 60%. Since no effective measures are being taken to hold the soil in place, the very earth on which crops depend is being washed into the valleys. . . . In a two weeks' trip from Valera to the Colombian border, not for one hour in the mountain zone did I see an area free from this destruction of the land!

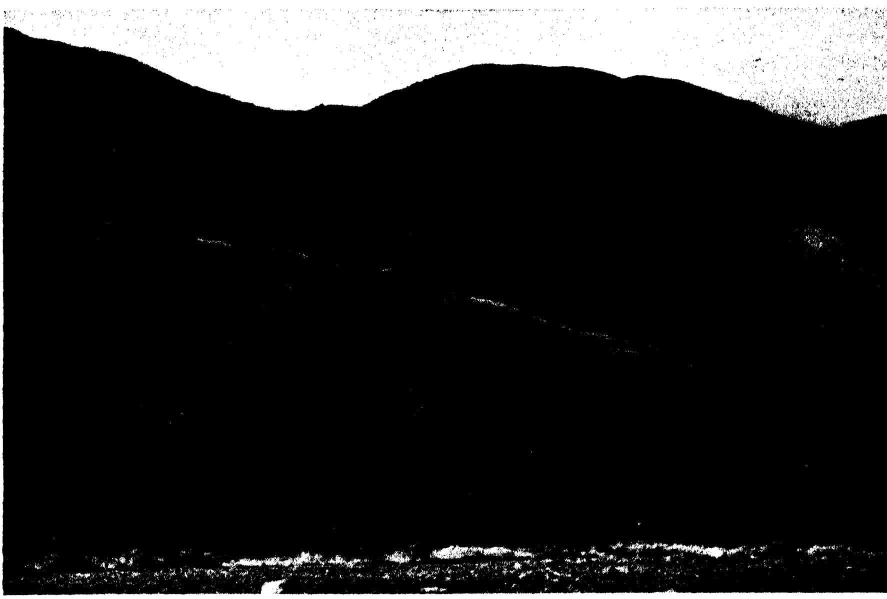

FIG. 1—Wheat fields clinging to a knife-edged ridge, on the only soil left. Near Jajó, Motatán River basin, south of Valera. (Photograph by courtesy of Pan American Union.)

"There are few countries in the world, and probably none in the Hemisphere, with more exaggerated and concentrated erosion. Over vast areas *all* of the soil has been washed away, leaving bare rock exposed. Throughout most of this area the fertile topsoil is gone and the productive capacity of the land has fallen to as little as the two bushels of corn per acre mentioned by Dr. Bennett—or to nothing."

Mr. Vogt describes well the needs and kinds of good conservation practices and the necessary governmental conservation service, which must have a strong and honest government, to find and stand back of a scientific, nonpolitical, and technically trained personnel with money to spend.

The prospects in Venezuela are implicit in Mr. Vogt's account of the educational situation. "Here, in Venezuela, the low educational level of the vast majority of the country's citizens is one of the highest stumbling blocks that an effective erosion control program will have to clear. 'Illiteracy' is a relative term. It is estimated that 70% of Venezuelans are unable to read and write. It is probable that at least 90% are possessed of such a limited education that natural resource conservation will have to be strongly emphasized over a period of several decades if the great mass of the people is to understand the necessity for soil and water conservation." Several decades! And what will be left by that time?

The explosive nature of the tragedy that overhangs Venezuela is due to its oil. Some 30 per cent of the food of the Venezuelans and the employment of many of them are said to depend on petroleum production and export. Some sad day, not too far away, there will be a swift decline—such is the nature of oil fields. What then? Sir John Boyd Orr reported Venezuela to be underfed before World War II.

All statements in this discussion need to be pondered in relation to two other background facts. The first is the population trend.

		BIRTHS	DEATHS			BIRTHS	DEATHS
Mexico	1944	958,119	447,198	El Salvador	1946	72,042	30,996
Costa Rica	1945	32,529	10,768	Venezuela	1945	154,489	64,136

The second is the government and its character. Many Latin-American countries have election by bullets and government by dictatorships. I think history is fairly clear on the nature of government by dictatorship. It is for the dictaror.—J. RUSSELL SMITH

GRASS: THE YEARBOOK OF AGRICULTURE 1948. xvi and 892 pp.; maps, diagrs., ills., bibliogr., index. U. S. Department of Agriculture, 1948. $2.00 (for sale by the Superintendent of Documents, Washington 25, D. C.). 9¼ x 5¾ inches.

In his preface to this, the seventh compendium in the United States Department of Agriculture's useful series of yearbooks devoted to particular aspects of farming, the editor remarks: "This book is the first word, so to speak, on the subject of grass, legumes, and the associated herbage . . . We hope it will not be the last word, because there is still much to be learned about subjects so diverse and plants so versatile." This is indeed a modest statement with which to introduce a vast amount of information.

"Grass" is mainly the work of a large number of scientist-contributors—agronomists, engineers, nutritionists, entomologists, pedologists, and others—but it is not altogether technical; cognizance has been taken of the fact that, because grasses and legumes "are so basic to farming and living, discussions of them must include a great deal about soils, geography, agricultural history, economics and marketing, genetics, public programs, and natural resources." In fact, geographers will find much of interest and value, particularly as regards conservation.

In the first part, appropriately titled "Grass in the Nation's Life," sections on such subjects as "A Permanent Agriculture," "Soil, Grass, Conservation," "The Range, A Major Resource," and "Grass for Happier Living" indicate the broad scope of the book. Progressing from the general to the particular, the second part discusses "Grass in the Ten Regions" of the United States, with emphasis on varieties and uses. The third part, "Grass in a Plant Roundup," considers "the nature and identification of the most important and most useful grasses, legumes, and associated plants," and the fourth part, "Grass in Charts and Tables," supplies a great deal of specific information on seeding, culture, species, and so on, and a comprehensive list of plant names, both common and scientific.

It is a hopeful sign that the farmers of the nation are coming to be more and more aware of the importance of grass and legumes in a well-adjusted land-use program; certainly the present volume will provide stimulus and encouragement to that end as well as a quantity of practical information.

FOREST INFLUENCES: THE EFFECTS OF WOODY VEGETATION ON CLIMATE, WATER, AND SOIL, WITH APPLICATIONS TO THE CONSERVATION OF WATER AND THE CONTROL OF FLOODS AND EROSION. By JOSEPH KITTREDGE. x and 394 pp.; maps, diagrs., bibliogr., index. (The American Forestry Series.) McGraw-Hill Book Co., New York, Toronto, London, 1948. $4.50. 9¼ x 6 inches.

Geographers are often confronted with the problems that arise from their efforts to integrate living beings and landscape into a logical sequence of causes and effects. Much has been said and written about the influence of physical factors on plant life, and very little about the influence of plant life on physical factors. The geographer concerned with the implications of large-scale deforestation or afforestation is likely to look for definite information regarding the role of trees in the balance of nature. Before the appearance of the volume under review, such information was seldom accessible, and to say that the book fills a definite gap is merely to state the obvious.

Like any other pioneering work, "Forest Influences" shows some lack of coordination here and there, some sign of haste in several places, but its value is not affected; a second edition, however, could easily make use of maps on a uniform scale and projection—to cite one instance that may interest the geographical reader.

The plan of the work is logical. Introductory chapters are followed by chapters dealing with forest influences on solar radiation and light, on air temperature, on wind, on atmospheric moisture, and on precipitation. Next come two important chapters on interception and stem flow and on fog drip. Evaporation and condensation are treated in Chapter 13, snow in Chapter 14. Four chapters are devoted to forest influences on soil physics—soil evaporation, soil temperature, the formation of litter and forest floor, and the retention of soil moisture. Chapter 19 deals with tree transpiration. The concluding chapters cover the "applied" aspects: runoff and stream flow, floods, erosion, and watershed management.

The great value of the book lies in the factual approach. Exact or tentative formulae are given whenever possible, so that various physiographic problems which used to be mentioned in a descriptive way can now be stated and solved mathematically. The research worker in mountain or forest physiography is thus equipped with a new tool. The general reader will find many misbeliefs dispelled.—J. GENTILLI

PUERTO RICAN EMIGRATION. By CLARENCE SENIOR. v and 166 pp. (mimeographed). Social Science Research Center, University of Puerto Rico, Río Piedras, 1947. $1.00. 10¼ x 7¼ inches.

The main thesis of this book is that emigration can contribute to the solution of the problems of overpopulation *only* if it is carefully organized and made a part of a broad program of population adjustment.

The author begins his scholarly study with a brief discussion of overpopulation and then describes the process and extent of Puerto Rican migrations to Arizona, the Dominican Republic, Hawaii, New York City, St. Croix, and South America. He next examines the difficulties and the causes of failure in certain organized migrations from the island. The contrasting attractions for the Puerto Rican migrant of New York City and of sparsely populated lands of Latin America are analyzed. The costs of emigration are compared with those of other suggestions for solving problems of overpopulation. A four-page summary states main conclusions and recommendations for action.

Although the work is of interest primarily to students of population problems, it contains information of value to authorities in other fields. Draft officials may be interested in the following item: Puerto Rican "recruiting officers announced the need for from 400 to 500 men in November, 1946. They were besieged by more than 1300 applicants who started standing in line at 5 a. m."

The study includes 28 tables to illustrate and emphasize points made and is exceptionally well documented with 179 footnotes. In the foreword mention is made of the plan of the Social Science Research Center of the University of Puerto Rico to "publish an exhaustive treatment of the subject in the fall of 1948."—EARL B. SHAW

COUNTY DATA BOOK: A Supplement to the Statistical Abstract of the United States. xiii and 431 pp.; maps. U. S. Department of Commerce, Bureau of the Census, 1947. $2.75 (for sale by the Superintendent of Documents, U. S. Government Printing Office). 11¾ x 9 inches.

This book provides a wide range of county data—91 items—under the major headings of population, labor force, housing, agriculture, industry and retail trade, and wholesale trade and service establishments plus 48 state-county outline maps readily adapted for use in plotting. Some relatively new county figures are given: estimated civilian population, November 1, 1943; births and deaths, 1944; residence telephones, January 1, 1945; type-of-farming areas, January, 1946; bank deposits, 1944; and E (War) Bond sales. These figures are placed in proper classificatory relationship with those of the Sixteenth Decennial (1940) Census. Thus is achieved a most useful, if not exciting, statistical reference book. One note, however: elaborate care is used to code the metropolitan counties to alphabetical lists and the 3099 counties to alphabetical state lists, but the map-minded searcher is given no special guide to find, say, San Saba County among the 254 counties of Texas or Jessamine County among the 120 counties of Kentucky. Why not yet another number guide for the position of counties on the state maps? It might be useful to introduce such a scheme for the publications of the next census.—MALCOLM J. PROUDFOOT

ORIGIN AND DEVELOPMENT OF CRATERS. By T. A. JAGGAR. xvii and 508 pp.; maps, diagrs., ills., bibliogr., index. *Geol. Soc. of America Memoir 21*, 1947. $6.00. 10 x 6½ inches.

Volcanologists have looked forward to the publication of this volume because of the great number of observations relating to Kilauea and Mauna Loa made by Dr. Jaggar over a long period of time. Many of the data have been reduced to ready reference form and are profusely illustrated with photographs of all phases of Hawaiian volcanism. Of the 417 pages of text, 332 are devoted to volcanoes in Hawaii.

Parts 1 and 3 are journals of the Hawaiian Volcano Observatory of volcanic activity at Kilauea. Part 1 is a day-by-day record from April, 1912, to June, 1913; the material has never before been printed "except as newspaper reports in Honolulu." Part 3 consists mainly of hour-to-hour observations, recorded day and night, for 22 days during the steam-blast eruption in 1924.

Part 2 is a summary of activity at Kilauea and Mauna Loa from 1909 to 1935, presented under headings and subheadings that indicate the features discussed. The text is enlivened

by many descriptive Jaggarisms—"gobbling noises," "bellying skins," "elephant hide" lava, "tadpole blisters," and others.

Part 4, "Series of Development Sketch Maps and Profiles of Halemaumau, Checked by Topographic Mapping, 1917–1934," contains also many of Dr. Jaggar's theories regarding the nature of the lava column, the differentiation of aa, the magmatic differentiation of basalt, the classification of hot basaltic magmas, and other subjects. Part 5 deals with Hawaiian crater histories and includes Dr. Jaggar's theory of a relation between eruptions and sunspot cycles.

Part 6, "Principles of Crater Evolution," starts with the earth as the offspring of the sun, includes a list of the classifications in volcanism, and concludes with crateral physics and chemistry.

Part 7 consists of a summary and conclusions, written by a man who has spent half a century observing volcanoes and who has lived, much of that time, in the caldera of Kilauea, with the fire pit of Halemaumau reflected in his conscious and unconscious mind.—HAROLD T. STEARNS

FONDAMENTI DI GEOGRAFIA GENERALE. By ROBERTO ALMAGIÀ. Part 1, ix and 373 pp.; Part 2, pp. 375–681; maps, diagrs., ills., bibliogr. Perrella, Rome [1945–1946]. 10 x 7 inches.

IL PAESAGGIO TERRESTRE. By RENATO BIASUTTI. vii and 379 pp.; maps, diagrs., ills., indexes. Unione Tipografico-Editrice Torinese, Turin, 1947. Lire 2800. 10 x 7 inches.

A work of geographical synthesis by an original scholar and experienced teacher is a real treat, and Professor Almagià's book, produced after nearly 40 years of academic experience, is no exception. The first 63 pages are devoted to the history of exploration and geographical knowledge; they are enriched by 12 reproductions of old maps, far more than are usual in books of this kind but not surprising in view of the author's studies in the history of geography.

A short introduction gives a table of the main subdivisions of geography and outlines the four fundamental principles of geographical method, namely distribution, coordination, causality, and correlation; to end this with Schultze's far too narrow definition of geography as the science of "landscapes and oceanic spaces" would seem somewhat in the nature of an anticlimax. It is perhaps unusual to include a discussion of Kepler's laws in a description of the solar system, but this no doubt clarifies several important points in the student's mind. Factual thoroughness is noticeable throughout, to the point of giving details of the calendar, which we so often take for granted, only to discover that most people are hazy about them.

The chapter on projections and maps is clear and effective; the slip in the caption to Figure 58 may be noted, where Eckert's sinusoidal equal-area projection is described as "elliptical."

"Physiography" opens with a chapter on the earth as a whole, in which mention is made of the "osul" (oxide-sulphide) layer between sial-sima and nife. The usual difficulty in teaching arts students is avoided by the inclusion of a chapter on elementary geology, with paragraphs on paleogeography and references to Wegener's and Milankovitch's work. The map showing the distribution of volcanoes is thorough, but the key does not indicate the basaltic areas, though they appear on the map. The discussion of meteorology is rather

disappointing, in that it does not mention the three-cell theory of atmospheric circulation and the concept of fronts; moreover, the description of tropical cyclones is illustrated, rather confusingly, with a map of the main cyclonic tracks and knots in the North Atlantic.

The chapters on the oceans, inland waters, and glaciers are well balanced and contain a wealth of information, without any undue burden of facts and figures. Geomorphology takes 58 pages. The chapter on climate is based on a simplified version of Köppen's system and includes a table of the areas of the climatic types on the continents and oceans; a welcome novelty is a section on climatic changes, both in the glacial periods and in historical time. Plant and animal geography end the first part of the book; soils are given only a few paragraphs in one of these chapters.

The second part, devoted to human geography, should earn Professor Almagià the gratitude of scholars and students alike; it is the work of a pioneer and veteran in the field. The introductory chapter ends on two warning notes: man's dependence on the natural environment should not be overrated; and that environment is continually changing. A short chapter on palethnology comes next. There is an absorbing account of the inhabited world—which, however, extends farther north in North America than shown in Figure 180—with an appendix on density and maps of distribution. The geography of human races follows, and a masterly and aptly illustrated essay is devoted to human settlements. Production and transport are dealt with in four chapters, and there is an excellent account of the peoples of the world and their cultural features, well illustrated with suitable maps.

Two important chapters on political geography are devoted to states and their structure. The volume closes with "general problems"—population and migration, and man as a geographical agent.

A treatise on landscapes may hold a pitfall for the author: if he leans on the analytical aspects, the amount of geomorphological or botanical detail may easily confuse the issue; if he tries to generalize, he may find himself writing just another geographical textbook. Biasutti has blended analysis and synthesis to a remarkable degree and has succeeded in producing an original and well-balanced work.

The first chapters deal systematically with the elements of landscape and are summed up in an outline of the main types of terrestrial landscapes (Chapter 12). Each regional landscape is then taken up, in itself and as it affects man—for instance, the "equatorial landscape" is followed by "man and the rain forest"—except where the human life of the region does not warrant a separate chapter. The final chapter discusses landscapes as affected by man.

The adoption of so controversial a concept as that of "landscape" as the central theme invites a critical examination of the methods followed by the author to arrive at his "landscape regions." Chapter 2 discusses the work of Passarge, Herbertson, Hettner, Banse, and others, but the reader is sent on to the following chapters for the author's views on the subject. The brief but clear discussion of thermal and moisture factors and the more detailed treatment of climatic classification lead gradually to a definition of climatic regions that follows Köppen's system with slight modifications suggested after a full consideration of the botanical significance of climatic boundaries according to Köppen, Passarge, Thornthwaite, Ackerman, and others. Vegetation regions are treated according to the system first adopted by Rübel and Brockmann-Jerosch, and a generalized table correlates climate and vegetation; it may be noted that three different climates correspond to the one *Laurilignosa* type of vegetation.

The landscape types, shown on a colored map, number 30. They are divided into climatic classes (*A* through *E*), and the classes into climatic-botanical zones (I through XI; two for each class except *C*, for which there are three). The zones are then divided into landscape types (*a*, *b*, *c*, etc.), which the author has named, with some hesitation, Amazonian, Sudanese, Iranian, Chilean, and so on. Climograms and botanical photographs illustrate each type.

The text is well printed and very well illustrated. It is preceded by a table of contents and followed by an index of geographical names and an index of authors quoted, features unusual in Italian books, and most welcome.—J. GENTILLI

THE GEOGRAPHY OF THE FLOWERING PLANTS. By RONALD GOOD. 403 pp.; maps, diagrs., ills., bibliogr., indexes. Longmans, Green & Co., London, New York, Toronto, 1947. 30s. (New York, 1948, $7.50). 10 x 6¼ inches.

This geography of the flowering plants is a distinguished study. In a well-organized manner it presents a mass of interesting data applicable to many of the basic problems and philosophies of natural science. Both philosophical and practical questions are considered intelligently and reasonably.

More than two-thirds of the book (Part I) may be fairly described as floristic plant geography, following an established and honorable tradition. After introductory chapters on the physical geography of the world, floristic regions, and the evolutionary background, Good falls into the main pattern of his treatment—a progression from families to genera to species, and from broad problems to local ones, the latter illustrated by the British flora. Types of geographic problems are nicely elaborated and well illustrated. In connection with genera and species, chapters are devoted to wide distributions, to endemics, and to discontinuities. This part closes with a discussion of historical plant geography. Part II deals with factors influencing distribution. It closes, logically, with an elaboration of "The Theory of Tolerance," which is associated with Good's name (*New Phytologist*, Vol. 30, 1931, pp. 149–171). Appendixes furnish statistics of the world's land masses and a list of discontinuous genera; an extensive bibliography and adequate indexes of the names of plants, persons, and places complete the book. The illustrations consist of 25 plates, many of them from the handsome "Vegetationsbilder" of Karsten and Schenck, and 71 text figures, including several original maps.

In his chapter on geographical changes as a factor in plant distribution, Good presents the case for continental drift. Wide biogeographical discontinuities are difficult to explain. Of the three general explanations, Good concludes that dispersal alone is inadequate and that there are grave objections to the view that land bridges are the main cause. As to the third possibility, he says: "The conception of continental drift affords a satisfactory explanation, but the theory is not yet universally accepted. The various objections to the theory of continental drift are gradually being resolved and there is every reasonable prospect that the theory will, in its final form, not only receive general support but will provide the desired explanation of many problems of plant geography." (As W. H. Camp has expressed it, "he prefers continental displacement to continental misplacement.")

The case for the theory of tolerance is really the case for physiological and ecological plant geography, as distinguished from the floristic approach. Good marshals the evidence skillfully and fairly and exposes the reasoning in favor of the modern understanding of plant geography.—STANLEY A. CAIN

SOME ASPECTS OF BRITISH CIVILIZATION. By H. J. FLEURE. 31 pp. (The Frazer Lecture, 1947.) Clarendon Press, Oxford, 1948. 9 x 5¾ inches.

THE BEGINNING OF CIVILIZATION IN AMERICA. By GILBERT N. LEWIS. Bibliogr. *Amer. Anthropologist*, Vol. 49 (N.S.), 1947, pp. 1–24.

ENVIRONMENT AND CULTURE DURING THE LAST DEGLACIATION. By CARL O. SAUER. Diagr. *Proc. Amer. Philos. Soc.*, Vol. 92, 1948, pp. 65–77.

These three papers, two of them by eminent geographers, the third by a noted scientist who was, until his death in 1946, head of the Department of Chemistry in the University of California, are distinguished by their breadth of interest and their vision of the antiquity of human culture patterns. Briefly, Fleure is concerned with tracing the diversities of contacts and environments that have enriched British life through the ages; Sauer discusses postglacial climates in North America and expounds a novel thesis on the Mesolithic environments and cultures of the Old World and the New. Lewis brings a mind trained in the exact sciences to bear on the complex data assembled by prehistorians, but, as so often happens when a scientist leaves his own field, he leaves behind him his training also. He writes as "a curious bystander," obviously impressed by the rapid growth of the study of human prehistory and fascinated by the doctrine of diffusion. Both the geographer and the archeologist will be wise to give this well-intentioned contribution a fair hearing, but they will realize that whereas Fleure and Sauer, however venturesome, are tried and trusted mariners sailing within the bounds of chronological probability and anchoring their theories in geographical facts, Lewis is adrift on a wondrous uncharted sea of his own. His reading has been wide, and his sources are generally sound. His conclusions, however, are simple, not to say naïve. He finds the arguments for the autochthonous development of American civilization and for diffusion across the Pacific equally convincing. Accordingly, he reverses the direction of diffusion and would see in the South American Indians the pioneers of world civilization. Transpacific diffusion ended about 3000 B.C., a date chosen apparently because the wheel, invented in Asia about that time (why not in America?), did not find its way to America, and because bronzeworking, an American discovery, became widespread in the Old World soon afterward, though, be it noted, one of the evidences of diffusion cited is the similarity between certain bronze knives found in Sweden (probably not earlier than 1500 B.C.) and in pre-Columbian America (undated).

The hypothetical Parent American Civilization had its home somewhere within the reaches of the Amazon and was forced to move in various directions when the Amazon Basin became climatically unsuited to high civilization. It is not clear why it should have declined to move into temperate South America or even to cross the Atlantic to Africa (at one point only 1500 nautical miles from Brazil) instead of climbing the Andes and crossing the Pacific, bridging that inconvenient gap of "only 2000 nautical miles" between South America and Easter Island which the classical diffusionist school did its best to overlook.

There are many points of detail and some major lines of argument with which one might disagree if it were worth while to say more about this ingenuous essay. The first part is cogently argued and shows promise of a more useful conclusion than the "Wild Surmise"—to use the author's own words—of the last pages. He would have done well to gaze longer at the Pacific.

Professor Fleure brings the wisdom of a lifetime of geographical thinking to bear on his analysis of the social evolution of Britain. It is a study that makes considerable demands on

the reader, who must have his wits about him as he is led breathlessly from the Old Stone Age to the depressed areas and the British Constitution. It is impossible to summarize what is itself a condensed summary, but we may select some of the general conclusions that emerge. The characteristic features of British life are derived from cross-fertilization of influences coming alternately from North and South Europe. The mingling of traditions led to a weakening of the grip of custom and a release of initiative, a process illustrated by examples drawn from many phases of history and prehistory and by the special contributions made to British life and thought by certain regions where diverse contacts have been experienced. We get many a hint, in brief word pictures of the major environments of Britain, of correlations between types of settlement, field systems, building styles, habits of life and thought, and so on, correlations that need to be worked out in detail. Out of these diversities has sprung the British genius of compromise, "the subtle interplay of streams of thought in an atmosphere that has tended to restrain compulsion . . . , [a] respect for conscience that . . . stands as Britain's most characteristic contribution to civilization." The essay is a striking illustration of the value, indeed the necessity, of an approach to truly interpretative geographical studies through archeology and history.

In Professor Sauer's paper we encounter the same sense of conviction of the significance of cultural origins. Archeologists have long been reluctant to concede any high antiquity to the occupation of the New World. Sauer refuses to interpret the physical evolution of North America to suit preconceived ideas of the antiquity of man and has been a constant champion of a wider outlook and a more liberal chronology. In the present paper he discusses at some length the duration and environmental conditions of the last deglaciation, which he places between *ca.* 33,000 and *ca.* 5000 B.C. He reaches the conclusion that the preceding pluvial climates of the subtropical belt were caused by the disappearance, not merely the displacement, of the "permanent" subtropical high-pressure belt. He does not extend this conclusion to the Old World, where distributions of land and sea areas are markedly different.

Sauer thinks that when once the subtropical highs were established in their present position, desiccation and deglaciation followed. He distrusts the vegetation sequence revealed by pollen analysis as evidence of progressive changes of climate and takes the view, which recalls Woodhead's work on the Pennine peats, that the plant successions are mainly due to edaphic changes. Here it may be interjected that Jessen's long-awaited publication on the Irish peats may be expected to throw light on this problem.

If the steppe-desert belt of subtropical latitudes was in existence in the beginning of deglaciation, it follows that we must look to other environments for the optimum conditions of life during the Mesolithic period. In northern Europe, as Grahame Clark and others are showing, the Mesolithic was an age of considerable vitality. Sauer would reinstate the long Neolithic phase of the older archeologists by regarding the Mesolithic as the full prelude to the Neolithic, possibly occupying the whole period of deglaciation and having its roots in the Paleolithic hand-ax cultures. He looks to Southeast Asia, where the eustatic rise of sea level had a maximum effect in providing sinuous coasts and drowned estuaries, as offering maximum opportunities for groups of progressive fresh-water fishermen. He supports his hypothesis with a wealth of suggestions touching man's oldest domesticated animals (dog and pig); the development of fishing techniques and boatbuilding; the use of poisonous stems and roots both for food and for providing fish poisons, fibers, cord, and cloth; the utilization of yams and sago; the practice of pounding and washing food; the germs of agricultural life, nucleated settlement, and gabled houses.

It is a measure of the originality of this brilliant piece of speculative writing that it leaves the reader bursting with questions and longing for more detailed evidence. Wide vistas of research are opened up in all directions; and comprehensive studies of the environments and cultures of Southeast Asia are an obvious need.—E. ESTYN EVANS

ANCIENT GREEK MARINERS. By WALTER WOODBURN HYDE. xi and 360 pp.; maps, bibliogr., index. Oxford University Press, New York, 1947. $5.00. 8½ x 5½ inches.

This is a history of ancient Greek maritime exploration from the Odyssey to the Periplus of the Erythraean Sea. The contributions of the Egyptians, Phoenicians, Carthaginians, and Romans are also included, and the problems of the African continent and the Nile are brought down to their solutions in modern times.

After the exploration of the Mediterranean and Black Seas had been completed in the sixth century before Christ, the Atlantic and Indian Oceans opened up inexhaustible fields of thought and action to ancient mariners and geographers. (Later the Caspian presented a little problem of its own, not treated in this book). Were these two bodies of water surrounded by land, like the Mediterranean, or ultimately continuous with each other, surrounding the continents themselves? The ancient world was permanently baffled by this question and failed to find the final answer. Nevertheless, many brave attempts were made, by scientific speculation as well as by actual navigation, which deserve our interest and admiration and have received it in numerous treatises devoted to the subject.

Professor Hyde's essay in this well-worked and well-known field is readable and informative but superficial and inaccurate. He overlooks the recent studies on Pytheas by Stefansson (1940) and on Hanno by Carcopino (1943). His conversion of Eratosthenes' circumference into 27,557 miles (p. 15) is incorrect. Eratosthenes cannot have used a stade of 177.42 meters. Ptolemy's "Geography" was not known only to the Arabs before it was translated at Rome in 1462 (p. 302). It was known at various times to the Byzantines, who in fact preserved it, and it was translated into Latin in Italy as early as 1405–1410. There are many other misstatements in detail too numerous to mention, and the bibliographical references are in general obsolete.—AUBREY DILLER

INTERNATIONAL STRAITS: A Treatise on International Law. By ERIK BRÜEL. Part [i.e. Volume] 1 translated by C. Byriel, Part [i.e. Volume] 2 by H. M. Pratt. Vol. 1, The General Legal Position of International Straits, 278 pp.; bibliogr. Vol. 2, Straits Comprised by Positive Regulations, 426 pp. Nyt Nordisk Forlag, Arnold Busck, Copenhagen; Sweet & Maxwell, Ltd., London, 1947. 10½ x 7 inches.

This work is a doctoral dissertation in the field of international law, with the strength and weakness which that implies. Prodigious research makes for difficult reading when each thread of inquiry must be followed out. But the text is intelligible to a reader who lacks legal training.

The core of Volume 1 consists of a fairly orthodox study of international law concerning straits. (Part I begins, customarily, with Grotius.) The author holds, however, that "the law of nations . . . must keep in the closest possible contact with reality." With this aim in mind, he presents a short, somewhat elementary, but clear introduction in which the geographical, naval, and political significance of straits is discussed. "Contact with reality" is also maintained by historical sections, notably those dealing with World War I.

The historical section leaves the reader with the impression that the "international"

law of straits is the resultant of national pressures. Brüel feels, nevertheless, that "normative forces of a uniform character . . . are at work within the whole of the sphere of international law now under discussion" and that "development proceeds in a logical direction i.e. in one in conformity with the function of straits." To reach this conclusion, he compares the modern international community with the national community of the Middle Ages, in which "the central authority . . . had to place certain interests of the community in the hands of individuals who owing to circumstances such as their presence on the spot appeared to be most suited to look after them." The Montreux Convention, which delegated power to Turkey, is cited as an example of this "turning the poacher into the gamekeeper." There seems to be a weakness in the reasoning, however, in the respect that the medieval national community had a central authority, which the international community lacks.

Air power is passed over lightly. Aviation, the author believes, does not change fundamentally the functions of straits. This conclusion appeared justified when the book was completed in 1940, but air power may reduce, and perhaps already has reduced, greatly the naval significance of straits.

Volume 2 consists of detailed studies of four straits: the Danish Straits, the Strait of Gibraltar, the Strait of Magellan, and the Turkish Straits. This volume will be of value to anyone making political, historical, or geographical studies in the regions in which these straits lie or in systematic fields such as maritime commerce or naval strategy.

An index is lacking, and Volume 2 has no bibliography. Footnotes are adequate and, in some cases, slyly witty (for example, footnote 2, Vol. 1, p. 34).—STEPHEN B. JONES

THE ANCIENT NA-KHI KINGDOM OF SOUTHWEST CHINA. By JOSEPH F. ROCK. Vol. 1, xx and 274 pp.; Vol. 2, v and 275–554 pp.; maps, ills., index. (Harvard-Yenching Institute Monograph Series, Vols. 8 and 9.) Harvard University Press, Cambridge, Mass., 1947. $25.00. 10¼ x 7 inches.

Few parts of the world present the anthropological variety or topographical interest to be found in southwestern China. Within Yunnan and western Szechwan live a variety of people, pushed into the headwaters area of the Mekong, the Salween, the Yangtze, and the Irrawady by tides of invasion from various directions. This is a little-known land, and one of great scenic beauty. Few scholars have given it critical attention, and none have lived in more intimate association with its primitive people than Joseph F. Rock.

The ancient kingdom of Na-khi centers in Yunnan and the upper bend of the Yangtze. These volumes provide a comprehensive view of the history, people, language, vegetation, and land use. There are telling glimpses of over-all geography, with a wealth of local detail, but no systematic study as such. Four districts are considered: Li-chiang, the area to the west and northwest, Yung-ning, and Yen-yüan.

Dr. Rock spent 12 years collecting data in the field, and the more popular accounts of his explorations have become familiar to readers of the *National Geographic Magazine*. These volumes, together with others promised, form a monumental contribution to our knowledge of the Tibetan borderlands. The documentation is voluminous, and the text is fortified with Chinese and Tibetan characters. Sixty-five pages are devoted to the index, and eleven to a gazetteer. Four sheets from the Army Map Service, United States Army, are provided. Publication is under the auspices of the Harvard-Yenching Institute, of which Dr. Rock is currently a research fellow.

This is a monograph of detail for the specialist, but the collection of 256 magnificent photographs reproduced in collotype will also interest the general reader. The rivers of western China flow through tremendous canyons, as much as 12,000 feet in depth, and are surrounded by peaks of more than 20,000 feet. The people are equally picturesque, and there is an excellent portrayal of land use.

Dr. Rock describes the inaccessibility of his area in these words: "To reach this region is an arduous undertaking, for it is about the most isolated in Asia. Sinkiang is certainly farther away, yet motor cars and aeroplanes bring it close to civilization. But here perhaps never will the sound of a motor horn be heard, for to construct a road over such mountains and deep gorges is a prohibitive undertaking. And planes? Let it be said that there is not even level space enough to pitch a tent, much less accommodate an aeroplane."—GEORGE B. CRESSEY

BIBLIOGRAPHY OF CHINESE GEOLOGY: BIBLIOGRAPHY OF GEOLOGY AND GEOGRAPHY OF SINKIANG. By HSIAO-FANG LI. vi and 213 pp. The National Geological Survey of China, Nanking, 1947. 10 x 7½ inches.

Li's bibliography is, so far as we are able to determine, the most comprehensive ever published on the geography and geology of Sinkiang. It covers almost the whole field of publications in Western languages and in addition includes a selected list of some original papers in Chinese.

However, there are a few glaring omissions. Russian literature on Sinkiang is poorly represented. No mention is made of A. N. Kuropatkin's "Kashgariya: Istoriko-geograficheskii Ocherk Strany" (Kashgaria: Historical and Geographical Sketch of the Country), St. Petersburg, 1879. As a treatise on the human geography of Sinkiang, Kuropatkin's book has no equal in any Western language. There is an English translation by Walter Edward Gowan, unfortunately both incomplete and poor. Nor are articles listed from such Soviet periodicals as *Novy Vostok* (*The Near East*), *Tihii Okean* (*The Pacific Ocean*), and *Izvestiya Vsesoyuznovo Geograficheskovo Obshestva* (*Bulletin of the U.S.S.R. Geographical Society*).

Some important Chinese works also cannot be found in Li's bibliography. The Chinese scholars of the nineteenth century showed a great interest in the geography of the northwest, especially of Sinkiang. The most valuable contributions of this period are "Hsi-yu shui-tao chi" (The Waterways of Sinkiang), by Hsu Sung, 1823, and "Hsin-chiang yao-lueh" (A Sketch of Sinkiang Geography), by Ch'i Yun-shih, written about 1800–1809.

Li likewise fails to mention "Chung-kuo ching-ying hsi-yu shih" (A History of Chinese Conquest and Administration in the Western Regions), by Tseng Wen-wu, Shanghai, 1937. Tseng's book, making the best use of Chinese and Uigur materials, is an invaluable source of information on the history and geography of Sinkiang.

Since the compilation of Li's bibliography several publications worthy of note have appeared. Among the most important is a new edition of N. M. Prejevalsky's monumental work, "Ot Kuldji za Tyan-shan i na Lob-nor," Moscow, 1947, with an introduction by M. Murzaev, a Soviet geographer of today. Other recent publications are "Gateway to Asia: Sinkiang," by Martin R. Norins, New York, 1944; "Hsin-chiang chih ching-chi" (Economic Conditions in Sinkiang), by Chang Chih-yi, Shanghai, 1946; "Delhi-Chungking," by K. P. S. Menon, Bombay, 1947; and "Sinkiang Survey," by members of the Walter Hines Page School of International Relations, The Johns Hopkins University, *Far Eastern Survey*, March 10, 1948.—CHANG CHIH-YI

ADMINISTRATIVE SUBDIVISIONS OF JAPAN. [By JEAN REISCHAUER and FRANK STEDMAN.] xv and 652 pp.; with a separate appendix (atlas) of 47 prefectural maps. *U. S. Dept. of State Publ. No. 2749 (Far Eastern Ser. No. 19).* [1947] 8½ x 13¾ inches; appendix volume, 20½ x 14¼ inches.

Geographers who engaged in research on Japan during World War II will recognize instantly the vast superiority of this administrative gazetteer over anything that existed during the war. It is a treasure house of exact and detailed data, "a listing," according to the subtitle, "of Japanese prefectures, cities, counties, towns, and townships, giving for each the area, the population for 1940 (adjusted to 1943 boundaries), and the population for 1945, with characters, romanized names, and a code showing location on accompanying maps." Its advantages are that for each of about 13,000 political divisions it gives (1) exact location and boundaries on a large-scale map, (2) United States government-approved romanized spelling of the name ("all changes in civil status and names shown through November 1943"), (3) the Japanese characters for the name, (4) the area in square kilometers (invaluable for checking changes in areas or for calculating densities of population), (5) population in 1940 (adjusted to 1943 boundaries), and (6) population according to the survey of November, 1945 (basic for an analysis of wartime changes).

The tables are arranged by prefectures from north to south. Each minor civil division has a code number indicating the prefecture and *gun* within which it is located. An alphabetical index to all names utilizes these code numbers to make possible a quick location of any unit in either the atlas volume or the statistical tables.

The introduction contains a note on the terminology of administrative subdivisions, a chart of the relationships of various types of areas, and a valuable table showing populations of prefectures and cities in 1940 (for both 1940 and 1943 boundaries), 1944, and 1945. The publication will be a fundamental reference for anyone working on the geography, demography, or administration of Japan.—CHAUNCY D. HARRIS

CH'ANG-CH'UN. By NORTON S. GINSBURG. Maps, ills. *Econ. Geogr.*, Vol. 23, 1947, pp. 290–307.

CH'ING-TAO: DEVELOPMENT AND LAND UTILIZATION. By NORTON S. GINSBURG. Maps, ills. *Ibid.*, Vol. 24, 1948, pp. 181–200.

Of particular interest at the present time are these two excellent studies of Chinese cities, both bearing the imprint of the Japanese occupation and both figuring prominently in recent news dispatches. Changchun had a population of more than 200,000 in 1936. It was an important railroad center and a seat of light industries. Tsingtao (with the suburbs, over 500,000 in 1938) has an excellent harbor and port facilities and railroad connections and important manufactories. In his instructive and well-written articles Mr. Ginsburg describes the development of each city pattern in the light of past history and present economy. Site, accessibility, strategic significance, industrial development, and building types are discussed.

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Two Hundred Thousand Maps

WHAT, you may ask, *is* a map collection? The answer, of course, depends upon who does the collecting. To the collector *per se*, it may be merely an accumulation of the old and intrinsically valuable in maps; to the sailor, it may be the charts that he has grown familiar with, together with those by which his forebears in earlier centuries navigated the seven seas; to the aviator, similarly, it may mean charts of the air routes; and, to the avid motorist, road maps from all over the world. To each and all of these map collectors, there is charm, fascination, and perhaps even nostalgia in the contemplation of his possessions.

But is this the basis on which a geographical society collects maps? Does romance or rarity determine the basis of choice when acquiring new items? The charms of sentiment must give way to the controls of fact, among them being the aims of the institution. For in 1852, when this Society was founded, one of its stated purposes was the collection of the maps, charts, and globes necessary for supplying full, accurate, and reliable information. We have never deserted this purpose, but instead have come to be leaned on so heavily for authoritative information that we are now considering the establishment of a separate department to receive and route the flow of inquiries. To consultation by the public must be added the demands made by the staff for reference and research. This collection of maps, then, is a *working collection* built for authority and operated for speed. That it functions well can be judged by the remarks of our not infrequent visitors from Washington, that it is often quicker to come directly to our map department than to make the necessary search through the Washington libraries.

Those working in the building think of the collection as being very large indeed, for its twelve active tons encroach more and more upon our limited space. But for sheer number of items it is no peer to that of the Library of Congress, where 4,000,000 maps are housed, or to those of other government collections. Your question may therefore be narrowed to this: What

is the policy of accessioning that renders the map collection so correctly fitted to its task in the service of geography?

In the first place, our collection is not "complete," nor do we wish it to be. Some published maps are merely copied from other maps, and represent no originality whatsoever—those we do not want, if we can find the original source from which they were taken. Distinguish, however, between "copied from" and "compiled from"; for the latter represents research based upon multiple source material and is in itself original. The appearance of new editions in quick succession, involving slight changes, is cause for the discarding of the older issues as replacements arrive. This holds true, for example, with the hydrographic charts issued by the various governments—yet the Curator must apply the rule with wisdom, lest the records of changes (so important in the detective work of geographers) of shore outlines and man-made developments be destroyed. The literature of real-estate holdings, vast, expensive, and of local interest only, is not collected with thoroughness, although the American county atlases of the nineteenth century constitute documents valuable in connection with the history of settlement, and our holdings in this field are both comprehensive and growing. Occasionally expediency forces us to limit our purchases, or situations arise in which we cannot even lay hands on certain series of maps which are known to exist—both deterrents marked for remedy at a future date. Duplicates are kept chiefly for their value in exchange. Discarded material is handed on to other institutions wherever further use is possible, as for example occurred recently when we equipped a Kentucky mountain school with its first set of wall maps.

Comprehensive without being definitive—to use the language of librarians—the Society's map department is strongest, perhaps, in its collection of serial maps of countries and regions, the kind that are produced by governments from original surveys. Of many types, these may be topographical, cadastral, or hydrographic, on large scale or on small. General reference maps (where places are) and communications maps (how to get there) are among those indispensable in answering inquiries from the public.

The Society is rich in its collections of early cartography, both in its maps and in its atlases. Perhaps its rarest and choicest specimens are the Leardo world map of *c.* 1452 and the Gerard Mercator world map of 1539. Atlases—2600 of them—requiring a separate room to house them, offer numerous examples of the works of the famous cartographers of the sixteenth, seventeenth, and eighteenth centuries, such as Ortelius, Mercator, Blaeu, Jansson, and Homann. Wonderful things they are, with pristine colors

spread upon stanch papers, priceless relics that recall what man's geographical knowledge was, period by period, down through history.

Town and city plans, those useful signposts of civilization, comprise an important section, and the Curator pleads for more. To professional geographers, however, the most significant today are maps that show distributions; for geographers, no longer satisfied to be mere describers and identifiers, have moved on to the study of earth patterns and the causes that lie behind change. It is at this point that our catalogue system rises to importance, for distributional maps are more likely than not to appear in periodicals.

The catalogue carries full information about individual topical maps appearing in books and periodicals acquired by the library, a service which we believe is unique. This helps the research worker enormously, especially since the indexing is carried to more than 300 subject classifications. Of the procedures and policies of the map collection we may boast a little; for a recent review of our "Manual for the Classification and Cataloguing of Maps in the Society's Collection" stated that our "map library is recognized today as one of the most efficiently operated in the world."

However, in reviewing recently the Society's limitations, as well as its values, we came upon two situations which cannot be permanently overlooked. In the first place, at the time when the Research Catalogue was introduced, a quarter of a century ago, the cataloguing of maps appearing in books and periodicals was commenced as of that date and was not carried backward to include the entire library—nor, for that matter, were the books themselves so entered. Secondly, the excellent map catalogue is usable only at the Society's headquarters, since no machinery has been set up either to publish it as a whole or to provide cumulative supplements.

You may well question the common sense of the proposal that this Society publish a catalogue of its map holdings as a service to others, when in fact those holdings are but one-tenth and one-twentieth, respectively, of the size of two known collections in Washington. But we repeat: ours is the *best working collection* of maps *in geography*, and it is to geography and geographers that we point our efforts. A complete and continuing representation of that collection, available in published volumes on the shelves of all libraries, would appear to be another of the fundamental links by which a strong geography can be built up in America.

RICHARD U. LIGHT

The Science of Human Climatology

Climate and Clothing

"It would be too much to say that clothing won the war, but it is true that without certain developments in clothing we could not have been successful, and it is the firm opinion of certain expert investigators that Germany lost the war when she made no provision for adequate clothing during the first Russian winter." Clothing is one of the elements that enter into the "science of human climatology" that came into being through "coordinated attacks" and "multidirectional approaches" during the global war. In an address "Human Climatology and Tropical Settlement" Douglas H. K. Lee speaks of the workings of the new science and its possibilities (University of Queensland, Brisbane, 1947). Of clothing he says: "By far the greatest scientific effort expended in this field was by the Office of the Quartermaster General of the United States Army. By a combination of good organization, sympathetic handling and vision, a large team of physicists, physiologists, climatologists, textile experts and 'clothing engineers' was assembled. They were given the material resources and assistance required for first-class work." One of the members of that group, Hoyt Lemons, collaborates with Dr. Lee in a first broad statement of the problem of "clothing for global man."

Among the obstacles to the creation of a science of human climatology have been the lack of quantitative knowledge of man's physiological adjustment to environment and a habit of thinking that finds the climatic norm in the lands about the North Atlantic Basin. The former is being met by work along two main lines, statistical analysis of field observations and laboratory experimentation; the latter must be resolved in part by psychology. There is, for instance, the attitude of the white settler in the tropics: he must regard himself as a *resident*, not a mere *sojourner;* his home must be firmly established in, and his life bound up with, the country of his adoption. This is one of the axioms emerging in a summary based on Dr. Lee's 21 years in tropical and subtropical Australia.

At the other end of the world, at Point Barrow, Alaska, is the Arctic Research Laboratory under contract with the Office of Naval Research. This station, situated in the most northerly settlement in United States territory on a site historic in Arctic exploration, is headquarters for Naval Petroleum Reserve No. 4. The story of its establishment is told by M. C. Shelesnyak in the Autumn, 1948, number of *Arctic.* The basic policy of the station is to provide facilities for fundamental research in all appropriate scientific fields re-

lated to the Arctic environment either carried on at the laboratory or using it as a base for field work. Operation began in 1947 with a program of metabolic studies in Arctic climates. Note may be made here of a letter by A. R. C. Butson on Antarctic acclimatization experiments (*Nature*, Jan. 22, 1949).

Although much research has been done on the effects of altitude in relation to aviation, little has been directed toward effects on permanent settlement; yet considerable numbers of the earth's population live at altitudes above 10,000 feet. Under American Geographical Society news we note the distribution of "Acclimatization in the Andes" by Carlos Monge of the Institute of Andean Biology in Peru. Studies by the Institute have revealed the reality of "high-altitude man" differing in many respects from his sea-level brother, and his "performance" must be measured by different standards. Study of altitude effects on the highland natives of New Guinea is suggested by Robert Bowman.

California Contrasts

At this writing (January 31) the editor feels a kinship with the copy writers and artists who prepare for Christmas at midsummer. "How Hot Is Death Valley?" A few days ago the Mojave Desert was snow covered and minimum temperatures of 10° F. were reported; at Indio in the Coachella it was 19°, and reports from Palm Springs "suddenly stopped coming in." The normally thriving tourist business at Furnace Creek Inn in Death Valley had suffered a bad slump. But the high temperatures of the Southwestern desert culminating in Death Valley remain the feature of permanent meteorological interest, and in this issue Arnold Court of the Environmental Protection Section of the OQMG examines the instrumental record up to date. He also points to the great differences within the air layer between the usual instrumental level and the superheated surface of the ground. Other aspects of change and contrast in the Southwestern desert are the subject of continuing investigation by Robert Glendinning. Here he takes up the basin, the Coachella, that includes Indio and Palm Springs; earlier papers dealt with Death Valley and the Hoover Dam area.

The basic influence of climate on man and his activities runs as a thread through James Parsons' discussion of California manufacturing—the empty spaces of the Mojave Desert that have made southern California the nation's leading center of aerodynamic research, the new "smog" problem, the water supply and power crises. "As the man-made superstructure of California's economy towers higher and higher, its dependence on the cooperation of a capricious Nature increases commensurately . . . serious doubts [exist] as to

the wisdom of continued expansion, at least until the economic application of atomic energy to peaceful ends has been demonstrated."

Irrigation and Dew

Summer drought and subtropical temperatures put their mark on the agriculture of the Mediterranean lands. Water is a precious commodity, and happy those places with ample supplies for irrigation. But water alone does not ensure prosperity. From the Middle East Centre for Arab Studies in the Lebanon comes the case history of some communities in Central Syria. It is a story involving misuse of water and land, erosion, silting of streams, formation of swamps, malaria. The cure here and elsewhere in the poverty-stricken Middle East is to be found only in a program "radical, comprehensive, and on a large-scale regional basis." Precious also is the "dew of heaven" which makes for the "fatness of the earth." Not all the Negeb is a dry, parched waste. Actual measurements show that in parts of this bitterly contested territory dewfall exceeds rainfall. Indeed, for Palestine as a whole dew is "a major factor in the water balance of the vegetation." From the Hebrew University of Jerusalem comes an appraisal of its significance.

Maps and the Hidden Map

"More than meets the eye" may be said of most of the maps in the *Geographical Review*. Size is no criterion: a page or half-page text map may conceal hours of thought and experimentation. The maps of Australia (p. 191), for example, are a translation into black and white of fifteen tints on the colored originals. This is typical of the work of our *Review* cartographer, Stanley F. Smith: some maps, he redraws, some he compiles; but to save time and expense the author's originals are used wherever possible. The overall railroad map of the United States (pp. 244–245) cost its author 500 hours of labor. The original map measured 47 by 31 inches; by careful trimming and by bleeding the cut it was possible to reduce it to text size and still keep the trackage system legible. Incidentally, the map serves also as a demonstration of the actuality of the great climatic divide at about the 100th meridian. A problem in reduction was likewise entailed in the functional-areas map of Dublin, another painstaking piece of work. Severance of the last link between Eire and Great Britain gives this map a timely interest and emphasizes the fact that Dublin in the past 30 years has achieved true "primacy" (Mark Jefferson: The Law of the Primate City, *Geogr. Rev.*, Vol. 29, 1939, pp. 226–232).

Fulfilling a promise made last October, Leonard Wilson tells of experiences in the establishment of a coordinated government map unit during the war (OSS) and draws therefrom conclusions of importance to both geography and government.

G. M. W.

CLOTHING FOR GLOBAL MAN

DOUGLAS H. K. LEE AND HOYT LEMONS

[With two separate maps]

FROM the time that he first tried to push beyond the confines of the warm environment in which he evolved from the lower primates, clothing has been of considerable importance to man. As with other necessities of life, many extraneous social factors have modified, and at times gained supremacy over, the fundamental biological requirements of clothing. The more complex the social organization, the more numerous and influential have these extraneous factors become. The human groups whose cultures have developed in relatively restricted areas have had ample time in which to establish clothing and other traditions in reasonable conformity with the prevailing environmental conditions, but those that have imported their culture from other climes have often been slow to sacrifice the traditional to the biological. Widely differing fashions that had successfully achieved their purpose of providing an adequate personal climate in highly inclement surroundings have been carried over into different and unsuitable environments.

Until the present century the loss of efficiency resulting from such nonconformity with physiological requirements did not seriously affect the progress of civilization, especially for those who lived in adequately protective buildings; but in the modern competitive world the increasing emphasis placed on efficiency has made such liberties less and less allowable. Global war brought matters to a head. Not only was loss of efficiency to be deplored, but tens of thousands of men were being rapidly transported from one climatic extreme to another, with no personal experience of any climate or culture other than that in which they had been reared. To guide them, or those responsible for their welfare, there was little formal knowledge.

To coordinate the available information, mostly empirical and individual as it was, and to apply it rapidly to the endless variety of environmental circumstance that men might be called on to face, was clearly impossible. Some underlying principle was needed, some universal scientific law, from which the clothing requirements for a given situation could be predicted when certain critical physical characteristics of that situation were known.

➤ DR. LEE, professor of physiological climatology and lecturer in physiological hygiene, The Johns Hopkins University, was formerly professor of physiology at the University of Queensland, Australia. DR. LEMONS is research director, Environmental Protection Section, Office of The Quartermaster General.

To this task the energies of scientists of many different kinds—physicists, physiologists, textile technologists, climatologists, geographers—were bent, not always in unison, not always with mutual recognition, but in the end with a fair degree of integration. The result was the extension of the old qualitative approach by a newer quantitative method, the rapid strengthening of the empirical by experimental evidence, and the formulation of mathematical principles capable of application, as fast as critical data were gathered, to any part of the climatic range. In this paper the authors propose to indicate the present position of our knowledge concerning the scientific prescription of clothing for any given range of climatic conditions.

Significance of Environmental Conditions for Man

Hardly any aspect of the environment is without some actual or potential significance for man, but the more important can be conveniently summarized according to the way in which they produce their major effects:

Thermal: temperature, vapor pressure, air movement, radiant energy.
Mechanical: wind, dust, precipitation, terrain, high humidity.
Psychological: monotony, frustration, excessive stress, glare.
Biological: resultant pathogenic organisms, their hosts, or otherwise noxious animal or plant forms.

It is also necessary to know, not only the immediate effect of the environmental conditions on man, but the way in which his body makes adjustments to the imposed stress.

THERMAL ASPECTS

The temperature of the surrounding air affects heat exchange between the body and the air by conduction from the skin surface and from the respiratory tract. It is normally the temperature given by a properly sited and shielded dry-bulb thermometer.[1] The temperature of other substances in contact with the body is of similar importance in proportion to the area of contact and the thermal diffusivity of the substance.

The vapor pressure of the surrounding air affects heat loss from the body by evaporation of (*a*) the water of true insensible perspiration diffusing through the tissues of the skin without the agency of the sweat glands, (*b*) sweat produced by the sweat glands, (*c*) moisture covering the lining of the respiratory tract, and (*d*) any other moisture present on the surface of the body. It is usually most conveniently measured by taking simultaneous readings of suitably sited wet- and dry-bulb thermometers, preferably

[1] For a precise account of the measuring of hot atmospheric conditions see T. Bedford: Environmental Warmth and Its Measurement, *Medical Research Council War Memo No. 17*, London, 1946.

subjected to a standard rate of air flow. Reference to appropriate tables gives the vapor pressure. It must be emphasized that it is the vapor pressure, or the related *absolute* humidity, which determines evaporation from surfaces of relatively constant temperature, such as that of the human body. Older work often attempted to describe this effect in terms of *relative* humidity, with obscure or even misleading results.

The rate of air movement affects heat exchange between the body surface and the air by conduction, and heat loss from the body surface by evaporation, approximately in proportion to the square root of the velocity. Inasmuch as light and variable air currents may be of importance to the body, air movement is best measured by a nondirectional and inertialess instrument such as the katathermometer or a hot-wire katharometer. For higher velocities a nondirectional mechanical anemometer will suffice. Meteorological records are taken almost exclusively with the last type.

Exchange of heat by radiation takes place between the body surface and surrounding objects according to the well-known Stefan-Boltzmann relationship; i.e. in proportion to the difference between the fourth powers of the absolute temperature of the body surface and that of the object. As this exchange does not depend on the intervening medium, aside from absorption in it, it is not affected by air movement, except to the extent that the surface temperature of the body or the object is itself altered by it. The extent of this exchange is often hard to determine. If the surroundings are at a fairly uniform temperature, the temperature loss or gain of some standard black body, such as the globe thermometer of Vernon and Bedford,[2] can be used. If only a part of the surroundings is involved, the emission from it can be measured by a suitable thermopile or by noting the rise of temperature of a standard absorptive surface. When an important fraction of the radiation to be measured lies in the infrared band, care must be taken that any protective covering over the absorptive surface or pile is highly transparent to such wave lengths. Glass will not do, and only a few plastics give sufficient transmission. Estimates of radiation exchange can also be made if the temperatures of the body surface and the surrounding objects, their emissivities, and their geometrical relationships are known. But man's geometrical form is notoriously variable. Space is not sufficient here to give examples of the complex estimations that are often necessary.

The following points should be noted: (1) Heat can be gained by, or lost from, the human body by conduction or radiation, according to the relative temperatures concerned. (2) Heat is lost from the body by evaporation. (3)

[2] *Ibid.*

Air movement facilitates heat exchange by conduction, in whichever direction it is taking place, and heat loss by evaporation.

To comprehend the effect of these thermal conditions we must examine the behavior of the human body.[3] In the first place, production of heat is an inescapable part of its existence. All the processes that characterize its living cells produce heat; the more active it is, the more heat it produces. More perhaps than any other animal, man desires freedom of action, freedom to be active when he wants to act, freedom to rest when he wants to rest. On the other hand, his internal temperature must be kept at a reasonably constant level if his tissues are to perform their very delicate functions efficiently. How is he to maintain such a balance between variable heat production and variable opportunities for heat loss to the environment? Under cold conditions he reduces the rate of flow of blood through his skin, lowering its temperature and thus the rate of heat loss to the environment. If this is insufficient, he increases his heat production by muscle tensing and shivering.[4] Voluntary increase of activity will also increase heat production, but at the expense of his highly prized freedom of action. Under hot conditions he increases the skin blood flow, raising its temperature and increasing heat loss, and he secretes sweat to increase the surface film of moisture on the skin and thus promote heat loss by evaporation. Other compensatory devices, such as crouching in the cold and relaxing in heat, diminished appetite and reduced desire for activity in heat, are less effective and also interfere with freedom of action.

In addition to his remarkable physiological powers of heat regulation, man enjoys the supreme benefit of reason, though, in Beach's[5] words, "in man himself there are many foes to reason, and one of the most powerful is habit. In some life situations, man's habits make him behave like an octopus when it comes to meeting new problems." The progress of house design, air conditioning, clothing design, and nutrition testifies to the ultimate, though slow, triumph of mental adaptation in extension of the physiological.

It must be borne in mind, of course, that the details of man's heat exchange with the environment vary widely, according, for instance, to his activity, body form, degree of acclimatization, and mental attitude. In any

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[3] For detailed references see the appropriate chapters in the *Annual Review of Physiology*, Vols. 1–10, Stanford University, Calif., 1939–1948.

[4] For a good account of physiological reactions to natural environments see E. F. Adolph and G. W. Molnar: Exchanges of Heat and Tolerances to Cold in Men Exposed to Outdoor Weather, *Amer. Journ. of Physiol.*, Vol. 146, 1946, pp. 507–537.

[5] F. A. Beach: Can Animals Reason?, *Natural History*, Vol. 57, 1948, pp. 112–116 and 137; reference on p. 114.

practical problem the investigator has to decide how far he is going to subdivide or restrict his consideration of major variables, and how far he is going to accept the remainder as "chance" variation. He then has the further task of determining the degree of this variation, and the range he will admit as significant or "normal." If his mind is clear on these points, man's variability need not provoke him to despair.

MECHANICAL ASPECTS

A breeze presents no great impediment to a lightly clad man walking over a level surface, but as the velocity of the wind, the projection of his clothed body, the roughness of the going, or the grade of ascent increases, the interference also increases, increasing the energy he must expend to maintain progress. This may reach critical proportions. Again, rapid convection of dry air over the surface of the skin, mucous membranes, or eyes may evaporate moisture much more rapidly than the normal processes can replace it, with consequent irritation or even damage to the tissues. Assisted by the wind, dust particles may produce various mechanical effects, from mild irritation of the eyes to abrasion of exposed parts of the skin. Interference with vision and chemical irritation by certain kinds of dust may be hazards. Heavy rain or snow, especially when driven by wind, may obscure vision. Hail[6] may at times constitute a mechanical hazard. The smoothness of wind-swept ice and the slipperiness of wet clay, or even of dry grass on a steep slope, considerably reduce the efficiency of walking by increasing the necessary expenditure of energy, or even jeopardize limb and life. Very rough terrain may have the same effect.

Heat and high humidity often produce an undesirable reaction of the human skin. The cause of the "prickly heat" universally encountered in the tropics was discovered independently by American[7] and Australian[8] workers during the war. It seems that under hot conditions, as a result of the frequent application of fat solvents, friction of clothing, and, perhaps, the imbibition of water by the superficial flaky cells of the skin, plugs of cornified material

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[6] Hoyt Lemons: Hail as a Factor in the Regional Climatology of the United States, *Geogr. Rev.*, Vol. 32, 1942, pp. 471–475.

[7] M. B. Sulzberger and others: Studies on Prickly Heat, *Journ. of Investigative Dermatology*, Vol. 7, 1946, pp. 53–68; the same: Tropical Anhidrotic Asthenia (Thermogenic Anhidrosis) and Its Relationship to Prickly Heat, *ibid.*, pp. 153–164.

[8] S. B. Allen and J. P. O'Brien: Tropical Anhidrotic Asthenia (Preliminary Report), *Medical Journ. of Australia*, Vol. 31, Part 2, 1944, pp. 335–336; and J. P. O'Brien: A Study of Miliaria Rubra, Tropical Anhidrosis and Anhidrotic Asthenia, *British Journ. of Dermatology and Syphilis*, Vol. 59, 1947, pp. 125–158; also D. H. K. Lee and R. K. Macpherson: Tropical Fatigue and Warfare, *Journ. of Applied Physiol.*, Vol. 1, 1948, pp. 60–72.

block the mouths of sweat glands, causing irritation and inflammation and interfering with the efficient cooling of the body. Rupture of the sweat glands under pressure of the accumulating sweat makes matters worse and may finally seal off the glands.

PSYCHOLOGICAL ASPECTS

Difficult to measure and overlapping others, psychological aspects are nevertheless of great importance—sometimes, indeed, of crucial importance. Possibly the most influential is monotony induced by lack of climatic variation or prolonged absence of the environmental elements that constitute the subject's prior conception of "normal" living; lack of sunshine for example, perhaps assisted by isolation from accustomed culture patterns. Frustration resulting from minor interference with desired activities is likely to loom large when the general outlook is already gloomy or stresses are heavy. Some dry winds seem to affect certain people out of all proportion to their thermal or mechanical significance.

Up to a point, the periodic application of stress to the human organism promotes a healthy development of reactive potential, but stress which is excessive in intensity or duration may exceed or even destroy the body's capacity for adjustment. This is true for psychological stress as well as for physiological. The critical level varies enormously with the individual and with the immediate circumstances. Many of us must have seen the transformation wrought in a "browned-off" soldier by a home-leave warrant. Glare is a sensation and as such is subject to all the fallacies that attend human judgment. The exciting physical cause is obviously an excessive intensity of illumination falling on the retina, but all sorts of coincidental conditions affect the critical level above which a sensation of glare results. Sharp contrast in intensity between different parts of the visual field lowers the threshold. The intensity of the infrared radiation, as well as that of the visible radiation, may play a part. The psychological condition of the subject is undoubtedly of great importance, as is opportunity for acclimatization. For these reasons some of us feel that the universal issue of dark glasses is a spuriously simple answer to a problem which has been insufficiently analyzed.

BIOLOGICAL ASPECTS

From protozoa to nemathelminths, from mosquitoes to pond snails, from scorpions to snakes, from grass seeds to stinging trees, all nature seems to conspire, especially in tropical areas, to set traps for unwary man. The controlling influence exerted by environmental conditions on the distribution

of animal and plant life is so well known, and described in so voluminous a literature, that we need only remind the reader that the biological aspects must often be taken into consideration in formulating practical schemes for affording man protection against the other, more directly operating, environmental hazards.

Mapping and Charting Environmental Conditions

Effectively to deal with the environmental factors and human reactions described above we must know their nature, intensity, and distribution by seasons and regions. This means they must be mapped.

Unfortunately, it is difficult to draw valid maps for world regions because of the paucity and limitations of reliable climatic data. Information is completely lacking for vast stretches of the earth's surface; for other broad regions observations are recorded for only two simple elements, temperature and precipitation. Furthermore, the validity of much of the material is open to question because of doubtful methods of recording, poor exposure of instruments, failure to use standard instruments, and other factors. Even the best data are not directly applicable to a study of body comfort because readings are taken at heights well above the center point of the body. Observations of vapor pressure and solar and terrestrial radiation are few; for most other elements only mean values exist. There is need for data on frequencies and variations—of wind, of maximum and minimum temperatures, of precipitation, and of sunshine—and on diurnal and annual ranges of temperature.

Data of this nature on a world-wide scale cannot be rapidly acquired; the more need therefore for pilot studies in microclimatology and microgeography—studies that would carefully assess temperature, humidity, radiation, wind, precipitation, and pressure, in local minuteness and at levels from the ground to six feet and up so as to reveal control effects of topographic features, land and water bodies, soil and regolith types, and vegetation types. Statistically valid methods for extrapolating meteorological values might thus be obtained.

CLOTHING ALLOWANCE ZONE MAP

Temperature is the climatic element for which most information is available, and under a wide variety of conditions it is the most important in determining man's need for clothing protection. A map suitable for determining annual clothing needs for broad earth regions must take into account annual variations of temperature between average hottest and average coldest months as well as mean annual temperatures.

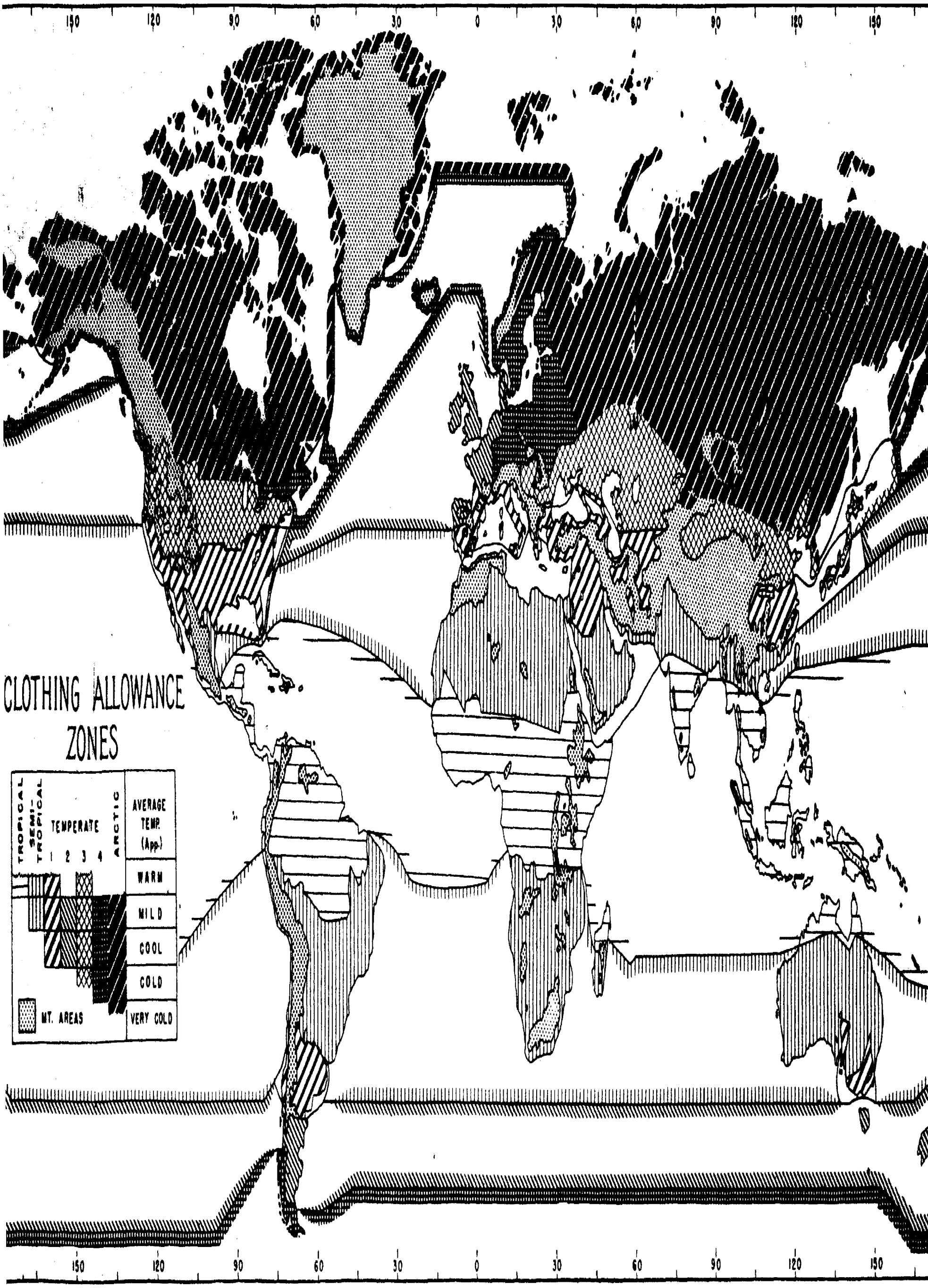


FIG. 1—World Clothing Allowance Zones. Clothing Requirement Areas (see Fig. 6 for example) are based on this system.

During most of the last war, issue of army clothing was based on three world regions: temperate, tropical, and arctic. These were neither well defined nor adequate. The inclusion of annual variation as well as the mean temperature provides a more scientific basis and allows for flexibility in subdivision. For simplicity, seven world regions have been established for army clothing requirements on this basis. Critical mean monthly temperatures are 14° F., 32° F., 50° F., 68° F., and 86° F., all physiologically significant for mapping. World maps are drawn using these isotherms, and their limits are then adjusted to meet practical considerations such as political boundaries. The result is a map of clothing-allowance zones (Fig. 1). In mountainous areas, which are specially delimited, altitude rather than latitude largely determines the location of the zonal boundaries. The seven clothing zones are: a tropical zone, a semitropical zone, four mid-latitude or "temperate" zones, and an Arctic zone.

Tropical Zone. This zone is defined roughly by the parallels of 20° N. and 20° S. The most important single climatological phenomenon is the constantly high level of temperature. Except in the high-altitude areas classified separately as "mountains," coolest-month mean temperature is 68° F. or higher. Protection procedures must consider not only the wet and humid rainy tropics but also the savannas, with their short periods of dryness, intense heat, and parched landscapes.

Adjustments may be difficult, with the body straining to cool itself. Evaporation is constantly needed to lower the body temperature, yet evaporation may be slow and inefficient because of high atmospheric humidity, and heat loss by conduction is difficult because the temperature of the air is near that of the body.

Semitropical Zone. This zone, whose coldest month is between 50° F. and 68° F., includes the low-latitude deserts and parts of the tropical steppes, tropical savannas, and subtropical climatic regions. Temperature ranges, both diurnal and seasonal, may be considerable. Freezing temperatures may occur in the cooler season and at night. Temperatures in certain areas in midsummer are among the world's highest. Moisture is deficient except in the humid subtropical regions and, for shorter periods, in the savannas and steppes.

Temperate Zones. The four mid-latitude or temperate zones are: Zone 1, 32° F. to more than 68°; Zone 2, 32° to 68°; Zone 3, below 32° to more than 68°; and Zone 4, 14° to 68°. The interior zones (1 and 3) have extremely large annual temperature ranges; in Zone 2, with a marine west-coast location, and Zone 4, with a marine east-coast location, the range is much smaller.

A difficult condition to guard against in these zones is the cold-wet, which occurs when temperatures average between 23° F. and 50° and there is considerable ground moisture. Such a condition may exist in Zone 2 throughout the year, in Zone 1 in fall, winter, and spring, and in Zones 3 and 4 in spring and fall and much of winter. Cold-wet conditions rank with hot-humid conditions in presenting difficulties for body protection. Clothing constantly wet loses a large percentage of its insulation. Wet clothing is extremely hard to dry. Slush and mud are underfoot. Respiratory diseases are common and constitute a serious problem.

Arctic Zone. This zone includes the Antarctic as well as the commonly recognized Arctic and Subarctic regions. The temperatures of the coldest months average below 14° F. This is a highly significant temperature, since it approximates the lowest temperature that an inactive man dressed in the best arctic clothing can tolerate for an indefinite period. A variety of summertime conditions occur throughout the zone. In its southern reaches in the Northern Hemisphere, warmest-month temperatures may average 68° F., and in interior locations absolute temperatures may go still higher. Over the icecaps of Greenland and Antarctica temperatures remain below freezing even in summer. In the matter of protection, therefore, summertime requirements are highly varied, whereas those of wintertime are relatively uniform.

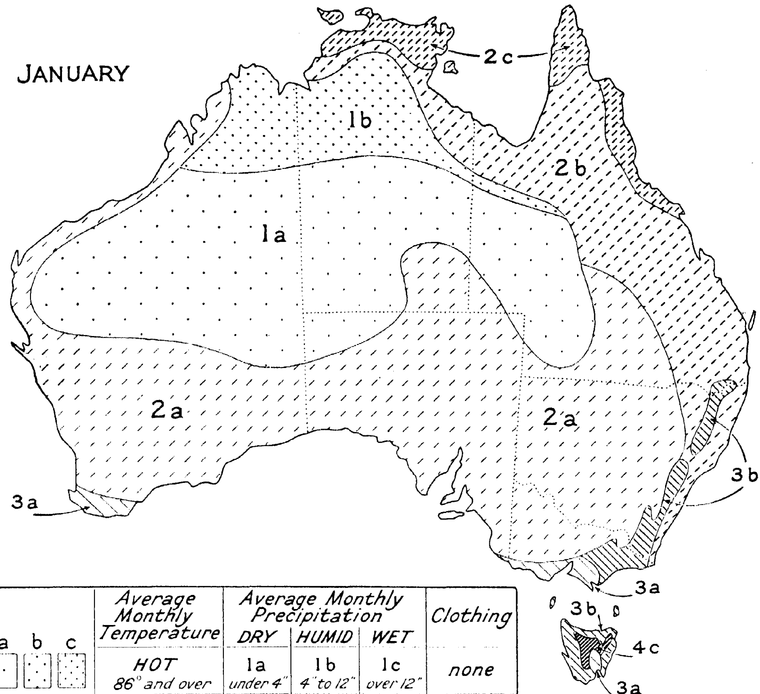
CLIMATIC ZONE MAPS

The Clothing Allowance Zone maps, designed for use in planning Army requirements, are equally suitable for predicting civilian clothing needs over broad regions and for the whole year. They are of limited value for smaller areas and shorter time intervals. For greater refinement in respect of place and time, maps of climatic zones based on average monthly climate have proved satisfactory for Army use.

The same significant isotherms are used on these maps as on the Clothing Allowance Zone maps, with three additional ones for low temperatures. Thus there are eight zones based on temperature: hot, warm, mild, cool, cold, very cold, extremely cold, and ultracold. The first six cover 18° F. intervals. The five warmest may be divided into dry, humid, and wet phases; the three coldest are considered functionally dry as regards protection needs because of the nonliquid form in which precipitation occurs at temperatures below freezing. Despite their limitations the maps do serve a purpose, however, until it is possible to refine them.[9]

[9] The climatic-zone maps are being revised for the OQMG by Clark University, incorporating diurnal range of temperature into the scheme.

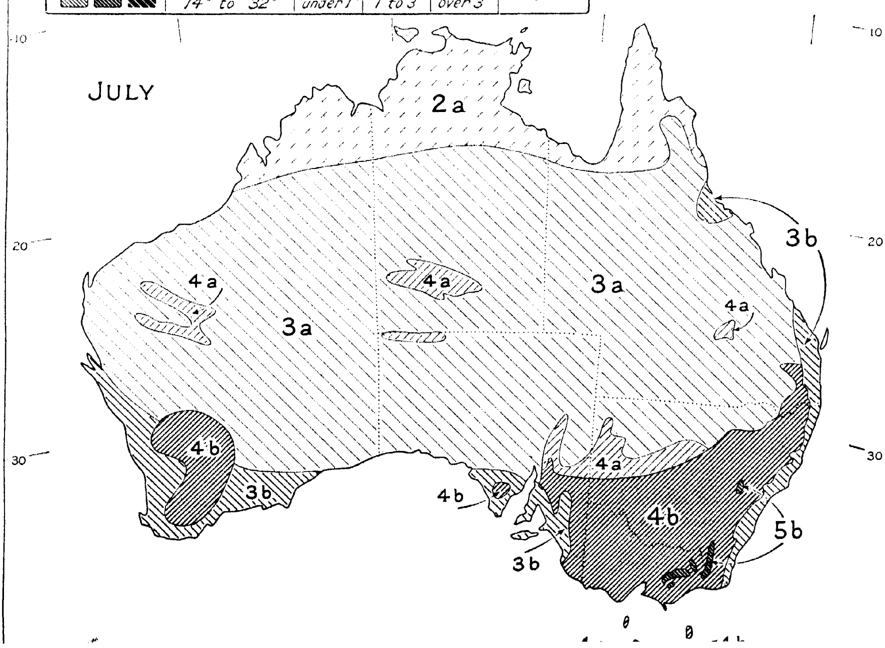
FIG. 2 (opposite)—Climatic Zones for Australia for January and July.



	Average Monthly Temperature	Average Monthly Precipitation DRY	HUMID	WET	Clothing
1	HOT 86° and over	1a under 4"	1b 4" to 12"	1c over 12"	none
2	WARM 68° to 86°	2a under 3"	2b 3" to 12"	2c over 12"	1 layer
3	MILD 50° to 68°	3a under 2"	3b 2" to 8"	3c over 8"	2 layers
4	COOL 32° to 50°	4a under 1"	4b 1" to 5"	4c over 5"	3 layers
5	COLD 14° to 32°	5a under 1"	5b 1" to 3"	5c over 3"	4 layers

0 500 Miles
0 500 Kilometers

Geogr. Review, Apr. 1949



Full sets of the maps, one for each month of the year in each of the continents, can be obtained from the Office of the Quartermaster General, Washington 25, D. C. Two examples, North America for January and July, given as separate maps, show how different combinations of temperature and precipitation are represented by different colors and shading criteria. These maps were reproduced by the Army Map Service. They are useful for comparing the monthly climatic patterns and protection needs of different areas, or of the same area at different times, as well as portraying the seasonal advance and retreat of climatic zones. Similar maps, but for seasons instead of months, are available for the ocean areas.

WIND CHILL AND OTHER MAPS

Supplementary are maps of a more special nature and smaller coverage. Maps showing the cooling effect of air movement and low temperatures on the human body were originally prepared by Siple from his heat-loss formula developed from experiments conducted in Antarctica in 1940 in which he determined the rate of freezing of water in a small plastic cylinder at various temperatures and wind speeds.[10]

Since its introduction about 1942, the concept of wind chill has been widely used to indicate the relative human discomfort due to weather, the year round in polar and subpolar regions, in winter elsewhere. Aside from mathematical considerations of the complete validity of the wind-chill formula, the maps indicate only one (though the most important) of several avenues of body heat loss under cold windy conditions.[11] This is heat loss by convective exchange with the air. Even though it is not completely understood, the chilling effect of strong wind at low temperatures is well known. A temperature of 20° F. below zero in still air is far preferable to 5° F. below zero with a wind velocity of 30 miles an hour.

Surface-condition maps have been prepared showing the probable condition of the ground as calculated from precipitation and temperature data. The charts were developed by Thornthwaite for the OQMG by use of a method based on the relationship of water need (potential evapotranspiration) to water supply (precipitation).[12] Its empirical derivation is a function of (1) the average monthly temperature, (2) a heat index, the sum of a function

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[10] P. A. Siple and C. F. Passel: Measurements of Dry Atmospheric Cooling in Subfreezing Temperatures, *Proc. Amer. Philos. Soc.*, Vol. 89, 1945, pp. 177–199.

[11] A critical evaluation of wind chill has recently been published. See Arnold Court: Wind Chill, *Bull. Amer. Meteorol. Soc.*, Vol. 29, 1948, pp. 487–493.

[12] C. W. Thornthwaite: An Approach toward a Rational Classification of Climate, *Geogr. Rev.*, Vol. 38, 1948, pp. 55–94.

of the 12 monthly mean temperatures, and (3) the length of day as a function of the latitude and time of year. The maps show eight classes of surface conditions, ranging from dry ground to permanent ice. They are useful in determining the requirements for articles that provide protection from the ground, such as shoes, boots, snowshoes, skis, sleds, and sleeping bags, and for various types of camping gear. They aid in the study of insect habitats and of soil trafficability problems.

Temperature-frequency maps are of great value in any attempt at analyzing the precise nature of the environmental forces affecting man, especially extreme temperatures. Such maps are being prepared by the OQMG, showing both absolute extreme and average extreme conditions.

The Thermal Basis for Clothing Design

Confronted by the necessity for reconciling many and possibly conflicting demands, it is convenient to start with that group which, in addition to being very important, lend themselves to scientific, quantitative treatment. Through the attention given to them of recent years, the thermal requirements constitute such a suitable departure point. Once the basic thermal requirements have been determined, the introduction of those modifications which might be indicated by other demands can be taken up, and compromises worked out.

EFFECT OF CLOTHING ON HEAT EXCHANGE BY RADIATION

When a barrier material is placed between two objects exchanging heat by radiation, the simple operation expressed by the Stefan-Boltzmann equation is complicated and a time factor introduced, as follows:

a) The net transmission is immediately reduced to an extent dependent on the nature of the interposed material and the wave lengths being emitted from the two objects. As a rule, clothing material interferes seriously with the direct transmission of radiation, a single layer letting through only 5 per cent or less.[13]

b) The interposed material may reflect a variable proportion of the radiation incident upon it. Most of the radiation reflected from the clothing surface away from the human body will be absorbed by the general surroundings and thus removed from the body-clothing system; most of the radiation reflected from the surface toward the body will be returned to

[13] Data of Aldrich, quoted by F. R. Wulsin: Report of Climatic Research Unit, OQMG, Aug. 8, 1943, and by H. F. Blum: The Solar Heat Load: Its Relationship to Total Heat Load and Its Relative Importance in the Design of Clothing. *Journ. of Clinical Investigation*, Vol. 24, 1945, pp. 712–721.

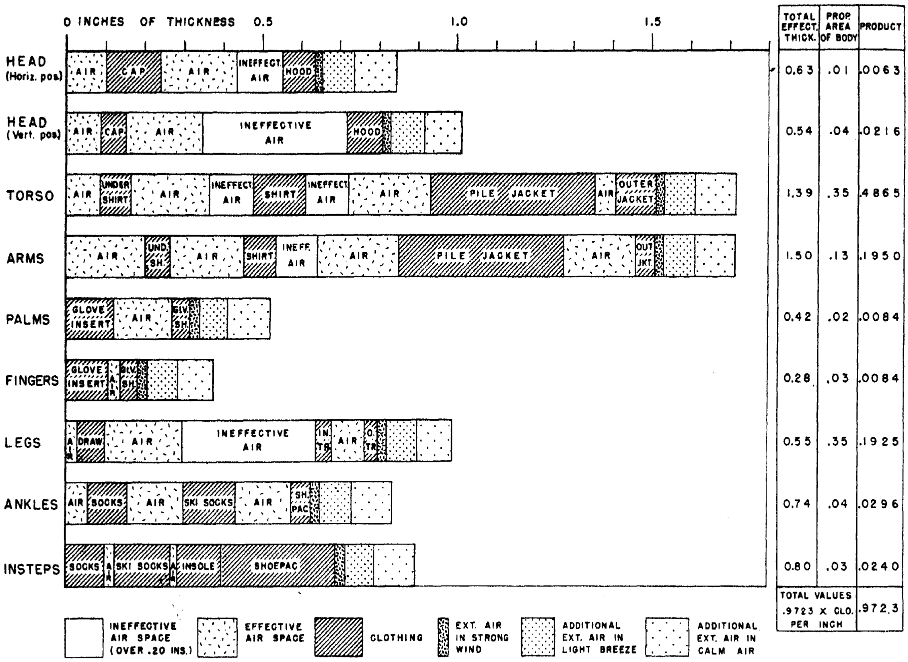

FIG. 3—To determine the approximate insulating value of a clothing assembly, or to study its distribution and adequacy over different parts of the body, the thickness of the clothing layers and of the air spaces between them are measured and plotted as a bar diagram.

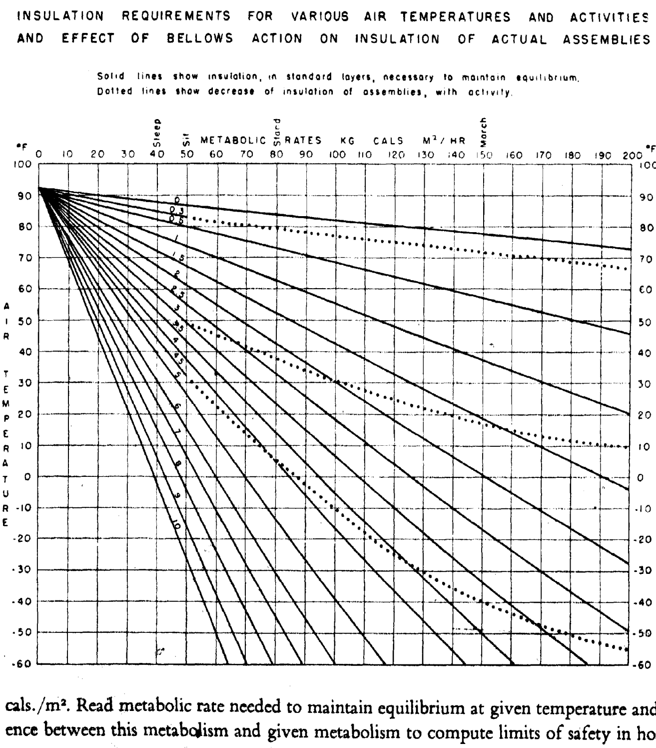

FIG. 4—Clothing assemblies are characterized by their thermal resistance at rest. If they preserved this resistance, the assemblies indicated by the straight lines would suffice to protect men working at the rate and at the air temperature expected. Because resistance is reduced by the "bellows action" set up through bodily movement, greater amounts of clothing, indicated by the curved lines, are required.

If standing be taken as average activity level, observe that one additional standard layer is needed for a temperature drop of about 18° F.

To compute tolerance times when clothing is inadequate, assume a possible body heat loss, without danger, of 80 kg. cals./m². Read metabolic rate needed to maintain equilibrium at given temperature and insulation. Divide 80 by difference between this metabolism and given metabolism to compute limits of safety in hours.

the body and absorbed by it once more. The net effect depends on the relative magnitude of the two processes. In general, reflection of the visible portion of sunlight varies with the brightness of the color; reflection of the short infrared portion of sunlight is fairly high (50 to 60 per cent); reflection of the long infrared radiation from hot nonluminous objects is much less (10 to 25 per cent).

c) That portion of radiation which is neither transmitted nor reflected is absorbed by the interposed material, the temperature of which is raised. The radiation emission of the clothing will therefore rise, and of the increase at least half will be inward toward the skin and the remainder outward from the body-clothing system. Thus the net interference effect, usually great at first, will be reduced with the passage of time. A material of high heat capacity may give marked interference for a time, but it loses this advantage when sufficient time has elapsed for equilibrium to be established.

d) Convection over the outer surface of the interposed material promotes heat loss from it to the ambient air. Convection over the inner surface likewise promotes heat loss, but in the case of clothing, design will determine whether this is conveyed to the underlying skin or to the exterior.

EFFECT OF CLOTHING ON HEAT EXCHANGE BY CONDUCTION-CONVECTION

The thermal resistance of clothing to heat transfer by conduction is very largely a function of the amount of still air held on the surface of the clothing, in its substance, and between successive layers. However, a thickness of more than 0.7 centimeter of air between successive layers adds little to the insulation value, since thermal convection currents must then be taken into consideration. Although the nature of the yarn and the texture of the fabric play some part in determining thermal resistance, the chief factor is the effective thickness of the assembly; in fact, the thickness as measured by standard methods may be taken as a guide to thermal resistance.[14] Figure 3 shows a work chart used in such calculations and Figure 4 the effect of bodily movement on thermal resistance. An alternative approach has recently been suggested by Yaglou.[15]

A special case is presented by the parts of the body in contact with solid objects, such as the ground. Here, thermal conductivity is greater through the external object than through air; the compression of the clothing (and

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[14] For a comprehensive account of these and similar methods see L. H. Newburgh and M. Harris: Clothing Test Methods, *Pub. CAM No. 390*, National Research Council, Washington, 1945.

[15] C. P. Yaglou: Thermal Insulation of Clothing, *Heating, Piping and Air Conditioning*, Vol. 20, No. 9, 1948, pp. 107–114 (with discussion).

perhaps its wetness) also increases its conductivity. Such a local increase of heat flow may be of importance to the part.

EFFECT OF CLOTHING ON HEAT EXCHANGE BY EVAPORATION-CONVECTION

From a free skin surface the water furnished by insensible perspiration or by sweating can usually be fairly readily evaporated, and the heat of vaporization is drawn almost entirely from the skin itself. Such evaporation is practically 100 per cent effective. When clothing is added, however, the situation is complicated:

a) Other channels of heat exchange are altered, so that under hot conditions the call made on evaporative cooling to maintain thermal balance may also be altered.

b) The diffusion of water vapor outward from the skin is impeded. Textiles differ in their permeability to water vapor, but this bears no simple relationship to their permeability to air.

c) The efficiency of convection over the skin is reduced by the mechanical barrier presented to external convection currents, and by the often narrow and usually irregular air spaces intercepted between the clothing layers and between the clothing and the skin.

d) Where clothing comes into contact with the skin, it may absorb free sweat. Under temperate to hot conditions this is likely to be evaporated finally from some part of the fabric at a distance from the skin, part of the heat of vaporization being drawn from the ambient air.[16]

e) Under cold external conditions water vapor diffusing outward from the skin may condense in some part of the fabric, returning some of its heat to the clothing system but increasing the thermal conductivity of the fabric by wetting it.[17]

f) Under hot conditions the rate of effective evaporation—the evaporation that results in cooling the skin—tends to be reduced by clothing. As a consequence, the extent of the water film on the skin (per cent wetted area) must be increased to maintain the necessary evaporation rate. When a complete film has been achieved, this method of body cooling has reached

[16] A. C. Burton: An Analysis of the Physiological Effects of Clothing in Hot Environments: Report to Aviation Medical Research Council of Canada, C 2754, SPC 186, Nov. 24, 1944.

[17] H. S. Belding and others: Thermal Responses and Efficiency of Sweating when Men are Dressed in Arctic Clothing and Exposed to Extreme Cold, *Amer. Journ. of Physiology*, Vol. 149, 1947, pp. 204–222; the same: Analysis of Factors Concerned in Maintaining Energy Balance for Dressed Men in Extreme Cold; Effects of Activity on the Protective Value and Comfort of an Arctic Uniform, *ibid.*, pp. 223–239. Also, S. Robinson and H. S. Belding: Protective Clothing, *in* Advances in Military Medicine, edited by E. C Andrus, 2 vols., Boston, 1948, Vol. 2, pp. 497–519 (Chap. 33).

its limit.[18] When the wetness of the skin surface exceeds that corresponding to 70 per cent wetted area, a special sense of discomfort may be experienced.[19]

g) The normal movements of the body set up a bellows action with the clothing. This increases heat transfer by convection between clothing layers, between the clothing and the skin, and between the skin and the ambient air. The thermal resistance of clothing as measured on resting persons is markedly and progressively reduced by exercise.

EFFECT OF CLOTHING ON BODY HEAT PRODUCTION

By its weight, restrictive effect, inconvenience, or production of discomfort, clothing can add to the metabolic rate required of the body for the performance of a given task or to the physiological strains, especially circulatory and nervous, involved in the maintenance of heat balance.

QUANTITATIVE ASSESSMENT OF THE THERMAL SIGNIFICANCE OF CLOTHING

Burton proposed general formulae[20] for expressing the effect of clothing on heat loss from the surface of the human body to a given environment. These may be combined into the following expression:

$$H = \frac{\frac{5w}{100}\left(p_s - p_o\right)}{r_{cl} + r_a} + \frac{C\left(t_s - t_o - \frac{RI_a}{C}\right)}{I_{cl} + I_a}$$

where H is heat loss in kcal./sq.m./hr.
w is per cent wetted area of skin
p_s is vapor pressure of air in mm.Hg. saturated at the temperature of the skin
p_o is vapor pressure of ambient air in mm.Hg.
r_{cl} and r_a are resistance of clothing and air respectively to passage of water vapor, in cm. of ideally still air*
C is a constant: 5.55 for °C., 3.09 for °F.
t_s and t_o are the temperatures of skin and ambient air respectively
I_{cl} and I_a are the insulation values of clothing and air respectively in "clo" units*
R is absorbed radiant energy in kcal./sq.m./hr.

*r_{cl} and I_{cl} are determined experimentally or calculated approximately from the measured thickness of the clothing assembly. r_a and I_a are obtained from standard curves, which give the values corrected for the estimated radius of curvature and velocity of ambient-air movement.

The "clo" unit referred to above is defined[21] as "that necessary to main-

[18] A. P. Gagge and others: Thermal Interchange between the Human Body and Its Atmospheric Environment, *Amer. Journ. of Hygiene*, Vol. 26, 1937, pp. 84–115.

[19] A. P. Gagge: A New Physiologic Variable Associated with Sensible and Insensible Perspiration, *Amer. Journ. of Physiology*, Vol. 120, 1937, pp. 277–287.

[20] Burton, *op. cit.* (see footnote 16, above).

[21] A. P. Gagge and others: A Practical System of Units for the Description of the Heat Exchange of Man with His Environment, *Science*, Vol. 94 (N.S.), 1941, pp. 428–430; reference on p. 429.

tain in comfort a sitting, resting subject in a normally ventilated room (air movement 20 feet/min.) at a temperature of 70° F. and a humidity less than 50%." However, it is now preferable to use physical units and express insulation in terms of the temperature difference maintained per kcal. of heat transfer per sq.m., per hour. Investigations have shown that 1 clo equals 0.18°C./kcal./sq.m./hr.

A little trial will show the many uses to which this equation could be put; for instance, in predicting the probable relative desirability of different clothing assemblies whose thermal characteristics are known, or in predicting the probable thermal state of a man wearing a given assembly under given conditions of work and environment. In its present form it has certain limitations, some of which may be removed by further investigation. In the first place, the equation applies only to equilibrium conditions. Greater tolerances than those indicated might often be possible for short periods of time.[22] Also, it makes no allowance for subclothing convection; i.e. conveyance of the air between the clothing and the skin directly to the exterior through openings by the agency of bellows action or atmospheric perflation. Thirdly, certain of the constants have not been determined over a sufficiently wide range of conditions, especially of higher wind velocities. Finally, the determination of R, the radiation absorbed, is itself difficult. To narrow the assumptions involved, Leighly has suggested methods of determining this approximately, but these have not yet been published.

Principles of Tropical Clothing

It would be pleasant to be able to say that a comprehensive survey has been made of the thermal properties of all available fabrics, that exhaustive consideration has been given to a very wide range of clothing designs, and that, as a result of these analyses, ideal recommendations can now be made for clothing to suit any particular set of environmental circumstances. It is not altogether impractical to think of such a situation, but so far neither time nor money has permitted the luxury of a purely scientific approach. Under the urgency of global warfare, only the most promising lines could be followed up, short cuts had to be taken, and many compromises agreed to. The following presentation of current principles is little more than a crude

[22] For the empirical determination of tolerance times to hot atmospheres in the laboratory and field, and the effect of clothing thereon, see S. Robinson and S. D. Gerking: OSRD Committee on Medical Research, *Clinical Investigation Rept. No. 48*, 1944; and the same: Thermal Balance of Men Working in Severe Heat, *Amer. Journ. of Physiology*, Vol. 149, 1947, pp. 476–488; also, W. B. Shelley and others: The Effect of Clothing on the Ability of Men to Work in Intense Heat, *Journ. of Clinical Investigation*, Vol. 25, 1946, pp. 437–446.

attempt to satisfy the general theoretical requirements by selection and use of fairly familiar pre-existing items.

In Table I (pp. 200–201) an attempt is made to summarize briefly the way in which the theory set forth influences the basic design of tropical clothing. It will frequently happen that conflicts arise between the listed conditions or that clothing is called on to protect coincidently against thermal stress and some other environmental hazard, notably disease-carrying insects. In these cases decision can be made only after careful consideration of the relative importance of the claims and, often, the practicability of providing one or the other. For instance, in the opinion of the authors, protection against mosquitoes and mites was the stronger claim in the early period of jungle warfare, but its relative importance decreased as other protective measures became effective and as warfare became more open. In the maintenance of garrisons and for much of the duty that armies of the future may have to perform in tropical regions, insect protection is unlikely to be a major function of clothing.

In Table II (pp. 200–201) are more specific recommendations made by one of us[23] for clothing design for hot climates. Beyond this it would be unwise for scientists to go unaided unless they have had considerable experience in the designing of practical clothing. It is at this point that the "clothing engineer" must take over, but, it is hoped, in a spirit of cooperation with the more theoretical scientist.

Principles of Arctic Clothing

It can be assumed that the general principle of increasing insulation by increasing the thickness of effectively dead air follows directly from what has been said in earlier sections. Because of the more complicated interaction of physical factors when the clothed human body is placed in a cold environment, and also because of the more extensive investigation of certain details of cold-weather clothing, more attention will be given here to specific problems.

CONDENSATION

Because cold-weather clothing is designed to protect the wearer under conditions of low activity, it becomes too warm when body heat production is increased by exercise. It is not always feasible to compensate by removing outer layers, and, since the clothing presents a fairly considerable barrier to

[23] D. H. K. Lee: Report of Second Commonwealth Inter-Service Conference on General Stores and Clothing, London, 1947.

TABLE I—THEORETICAL CONSIDERATIONS IN THE PRINCIPLES OF CLOTHING DESIGN FOR THE TROPICS

CONDITIONS	COLOR	TEXTURE	THICKNESS	WATER VAPOR PERMEABILITY	WEIGHT
Solar radiation	Light Dye type important	Close	Moderate	Moderate to high	Medium
Radiation from hot objects	Immaterial	Close	Moderate	Moderate to high	Medium
Hot dry air	Immaterial	Close	Moderate to thick according to wind	Moderate	Medium
Hot humid air	Immaterial	Open	Thin	High	Light to medium
Tropical rain	Immaterial	Impermeable to water	Thin	As much as is consistent with water exclusion	Light

TABLE II—NOTES ON SPECIFIC ITEMS OF TROPICAL CLOTHING

Headgear

a. The solar thermal load on the head is not very great but may be significant, especially if the hair is thin.
b. Solar radiation has no special local effect on the head, neck, or brain.
c. Protection from sky (and sun) glare is important.
d. Protection from rain and dirt is advantageous.
e. Light weight, separation of the crown from the scalp, and aeration of the enclosed space is desirable.
f. Polished metal foil lining is possibly advantageous.

Underclothing

a. Generally desirable in hot dry atmospheres, undesirable in hot humid ones.
b. Frequent washing is essential.
c. Light weight and water absorbency are required.
d. A scrotal suspender is sometimes desirable.

One-piece Main Garment

a. Thermal advantages are the absence of constrictions, dependence from the shoulders, free bellows action, and freedom of body movement.
b. Disadvantages are difficulty of removal, impracticability of discarding upper portion when desired for increased convection, latrine difficulties, and necessity for renewing whole garment when wear or damage is only local.

Upper Main Garment

a. It should be designed to extend down outside the lower garment, when convection is important, or to be tucked inside when air is to be excluded.
b. The neck should be capable of being opened for convection or closed for exclusion.
c. Sleeves should be long for dry conditions, with buttons; but rollable or short, for humid conditions.
d. If sufficient free convection is provided by openings for use in the humid tropics, the material could still be relatively dense.
e. The safari jacket type could be made to meet all these requirements, the method of wearing being varied with circumstances. It could be the basic design for both male and female wear.

TABLE I—cont.

EXTENT	OPENINGS	FIT	WATER REPELLANCY	UNDERCLOTHES	CONDITIONS
Well covered	Not important	Loose	Nil	Moderately desirable	Solar radiation
Well covered toward source	Depends upon humidity. Away from source	Loose	Nil	Depends upon humidity	Radiation from hot objects
Well covered	Minimum	Loose	Nil	Moderately desirable	Hot dry air
Minimum	Extensive	Good, not tight. Well cut. No constrictions	Nil unless rain resistance required	Minimum	Hot humid air
Adequate protection	Facing downwards	Loose	Complete. Superimposed removable covering		Tropical rain

TABLE II—cont'd.

Lower Male Main Garment

a. For the arid tropics, slacks of relatively dense and durable material are desirable, and a belt may be worn.
b. For the humid tropics, shorts are highly desirable. The waistband should be loose and the garment supported by strongly affixed straps passing over the shoulders under the upper garment. No belt should be allowed to interfere with convection or to maintain a wet rubbed area round the abdomen.

Lower Female Main Garment

a. Slacks are desirable for hot dry wind, otherwise skirt of dense material is adequate.
b. For hot humid conditions the skirt is ideal, especially if relatively short and full.

Socks and Stockings

a. When slacks are worn, short socks suffice.
b. When shorts are worn, short socks are still thermally preferable, though untidy. Stockings should be light-weight, at least in the leg, and absorbent.
c. For protection, loose leather gaiters may be added, but for the minimum necessary period. Puttees are not desirable.
d. In hot humid climates anklets or any other form of constrictive or thermally resistant material round the ankle should be prohibited, especially if slacks are worn.
e. The feet of socks or stockings should not be heavier than is necessary for comfort in walking, and should be absorbent.

Boots and Shoes

a. At all times they should be as light as is consistent with comfort in walking and durability; but sand shoes should be prohibited, except for occasional special use.
b. The uppers should be as low as possible.
c. Where hot ground is the rule, insulation should be included in the soles.

Aerated Clothing

a. For occasional special use, where other methods are inapplicable, the introduction of air between the clothing and the skin greatly improves conditions.
b. For an acclimatized man doing moderate work at air temperatures of 100°F., 8 cfm of air at a dew point of 83°F. gives acceptable relief, while 16 cfm of this air or 8 cfm of air at a dew point of 65°F. gives very pleasant conditions.

NOMOGRAM OF DRY-SHADE ATMOSPHERIC COOLING

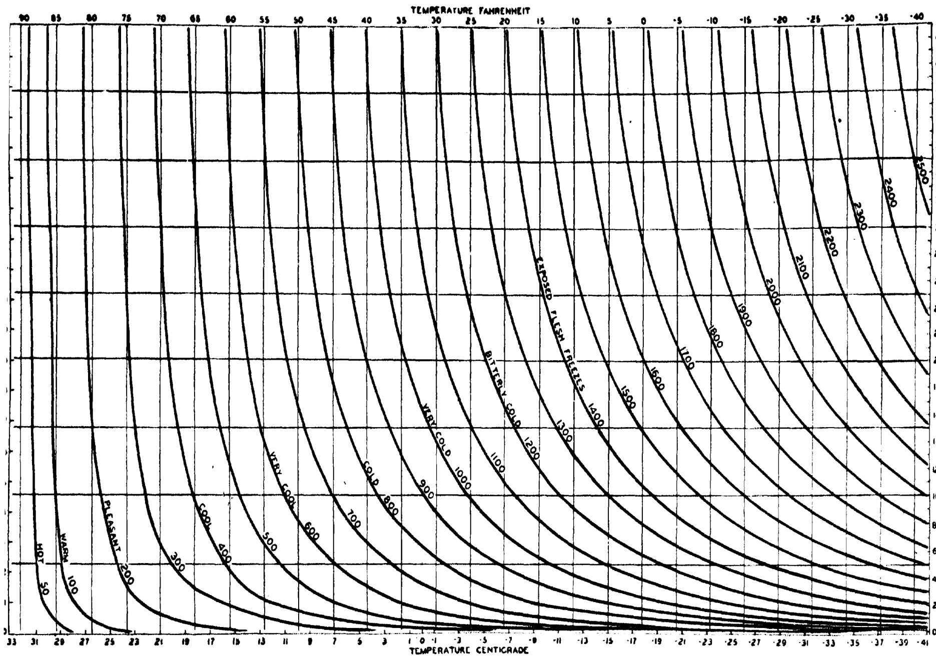

FIG. 5—Cooling is expressed in kilogram calories per square meter per hour for various temperatures and wind velocities. The cooling rate is based upon a body at a neutral skin temperature of 33° C (91.4° F). When the dry cooling rate is less than the rate of body heat production, excess heat is removed by vaporization. Under conditions of bright sunshine cooling is reduced by about 200 calories. Expressions of relative comfort are based upon an individual in a state of inactivity.

water vapor, the rate of sweat production is likely to be high. This may set in train a complicated series of events.[24] In the first place, the sweat will soak into the clothing and evaporate at some distance from the skin, so that it is less effective in cooling the body during its period of high heat production. Secondly, water vapor formed by evaporation, in diffusing through the clothing layers, through which there is a considerable thermal gradient, is likely to arrive at the dew point before it escapes and precipitate in the clothing, setting free heat, which will partly undo the cooling effect of the previous evaporation. Thirdly, the water in the fabric, whether it came from direct absorption of sweat or from condensation of vapor, may be frozen in the outer layers. The ice formation hinders work and greatly increases the thermal conductivity of the clothing assembly, a condition that may be critical after activity has ceased if clothing cannot be changed.

[24] See the references cited in footnote 17, above.

WET COLD

At temperatures consistently below freezing, there is no problem of environmental wetness, but around the freezing point free water from outside or snow melted by contact with the warmer clothing can readily penetrate it. The thermal conductivity of the clothing is increased by wetness, and at freezing and near-freezing temperatures critical heat losses may result from the body as a whole, or from the extremities, which are least able to maintain their temperature under cold conditions. Also, solar radiation is likely to be weak and unreliable. An outer water-repellent or even waterproof layer may be needed, especially over the extremities.

VAPOR-BARRIER PRINCIPLE[25]

To prevent the permeation of clothing by water derived from the skin, a vaporproof layer next to the skin seems logical. This, however, raises a twofold problem. The water of true insensible perspiration diffuses through the skin in accordance with simple physical laws and does not require the agency of sweat glands or any other living cells. Diffusion ceases when the skin is covered with a film of moisture. If the vapor pressure between the skin and the clothing is allowed to rise until the air is saturated at the temperature of the skin, not only will the water from true insensible perspiration be prevented from soaking into the clothing, but its formation will be kept down to a low level. This condition can be rapidly achieved if a vaporproof layer lines the clothing and outlets to the environment from the small space between it and the skin are minimized. If, however, the thermal condition of the body requires that evaporation take place from the skin, then the sweat glands will come into action, and they will not be repressed by wetness of the skin or saturation of the air space between the vapor-barrier layer and the skin. Water will now accumulate in the space, and the body temperature will rise. Ventilation of the space is now imperative. As this condition is very likely to occur, for reasons mentioned above, clothing embodying the vapor-barrier principle must be provided with controllable subclothing convection. Current designs provide this by means of openings at neck, waist, and cuff controlled by adjustable cords.

CONVECTIVE HEAT LOSS[26]

Heat loss to cold air is greatly increased by external convection (Fig. 5).

[25] The idea of the vapor-barrier layer was first formulated by P. A. Siple, in consultation with H. C. Bazett. The principle of controlled ventilation has largely been developed by A. Woodcock.

[26] A clear presentation of these points is given in: Minutes of Conference on "The Principles of Environmental Stress on Soldiers," Climatology and Environmental Protection Section, OQMG, Aug. 25, 1944.

To a certain extent, high external air movements cause turbulence in the still air within the clothing fabric, and this can be considerably reduced by providing an outer "windbreak" layer of tightly woven material. The effectiveness of air movement increases with the radius of curvature of the part, so that when successive insulating layers are added to a part of the body of small diameter, the value of each successive layer may be considerably reduced, under windy conditions, by the increased effect of convection.

RESPIRATORY PREHEATING

When cold outside air is inhaled, a considerable amount of body heat is added to it by conduction and evaporation. When air is exhaled, this heat is lost to the body. If the incoming cold air is allowed to absorb some of the heat from the outgoing warm air, some conservation may be effected. Exchange of sensible heat can be brought about without mixing of the inspired and expired air, but for conservation of the usually greater amounts of latent heat, mixing seems to be unavoidable. This, unfortunately, tends to undo the primary purpose of respiration—the preservation of a high oxygen, low carbon-dioxide concentration in the alveolar air of the lungs. A compromise can be effected, as with an antigas respirator, but only at the expense of the work capacity of the individual. Under many conditions this may not be a critical matter, and a simple preheating mask can then be very useful.

CLOTHING ALMANACS

The best suit of clothing imaginable, correctly designed, built, and fitted to afford adequate protection from the rigors of the environment, is useless if it is not available when needed. By a happy integration of geographical and physiological principles a simple yet systematic and effective device for determining clothing requirements for field troops for any place in the world and for any time of the year was developed during World War II—the "Clothing Almanac."[27] The Almanac is essentially a manual in which a person can find what clothing he will require in a given part of the world at any time of the year. In it scientific principles are reduced to clear, practical instructions.

Four sets of factors determine clothing requirements: thermal aspects,

[27] The Clothing Almanac was originally conceived by P. A. Siple in his report on "The Adequacy of Winter Clothing in the European Theater of Operations for 1944–45." The first almanac was developed by the Environmental Protection Section, OQMG, for the logistic planning for the invasion of Japan.

other environmental aspects, functional aspects, and necessity of utilizing existing supplies.

Thermal aspects are essentially a function of (*a*) bodily activity levels, (*b*) clothing materials and garment assemblies with respect to heat conservation, and (*c*) prevailing environmental conditions.

The hour-by-hour activity of an outdoor man, as exemplified by a combat soldier, is constantly varying. For issue of clothing some level had to be selected as standard, or "average." This level, chosen after analyses had been made of activities over the 24 hours checked against average hourly caloric intake of food, is approximated by the activity of a man "standing around or performing very light tasks" (hourly expenditure of about 75 to 90 kcals./sq.m./hr.) To maintain thermal equilibrium, other factors remaining constant, increase of activity necessitates removal of garments, and decrease of activity necessitates addition of garments.

Almost the whole range of easily available clothing materials have been examined to determine resistance to heat transfer, permeability to water vapor, water absorbency and repellency, windproofness, reflectivity of radiation, and so on. In addition, experimental production of highly specialized materials has been undertaken, and the practicability of their use for clothing has been considered. The following data from Aldrich[28] illustrate the type of information being accumulated.

PERCENTAGE REFLECTION OF SUNLIGHT BY VARIOUS FABRICS

	TOTAL SUNLIGHT Adding to heat load	TOTAL SUNLIGHT Reflected	TOTAL SUNLIGHT Transmitted	VISIBLE 0.3μ to 0.7μ	INFRARED 0.7μ to 2.5μ
1. Shirt, Mock Leno, slightly permeable	55.9	44.1	5.1	24.1	53.7
2. Cotton, khaki-8.2 oz.	43.7	56.3	0.0	27.8	64.5
3. Cotton, percale, white	33.2	66.8	0.5	69.3	60.2
4. Cotton, percale, O.D.	51.5	48.5	2.5	28.8	55.0
5. Cotton, tubular balbriggan	37.6	62.4	3.2	62.7	58.3
6. Cotton, twill, khaki	48.3	51.7	0.2	25.8	58.9
7. Cotton, shirting worsted, O.D.	61.1	38.9	0.1	72.1	49.0
8. Cotton denim, blue	67.4	32.6	0.0	12.1	49.0
9. Cotton, herringbone twill	73.7	26.3	0.1	13.3	30.2
10. Cotton, duck No. 746	92.8	7.2	0.0	6.6	7.5
11. Cotton shirt, white unstarched, 2 thicknesses	29.0	71.0			
12. Cotton shirt, khaki	57.0	43.0			
13. Flannel suiting, dark gray	88.0	12.0			
14. Dress suit	95.0	5.0			

See the references cited in footnote 13, above.

When clothing materials are combined and tailored to make clothing assemblies, conditions are modified, and further investigation is necessary. For example, to provide adequate protection to the body as a whole and to each of its parts, clothing must (1) fit properly and (2) provide a balance of protection for all the parts. Tight-fitting garments bring adjacent fabrics together, so that the included dead air is expelled. Bulkiness and warmth are nearly synonomous. Insulation for the entire body is most efficient over the parts with relatively smallest diameters, since surface area for heat loss increases faster then insulation thickness. Hindrance to movement resulting from bulkiness is also a limiting factor; therefore the optimum practical thickness for affording balanced protection is about as follows: fingers, a quarter of an inch; hands and feet, an inch and a half; torso, two inches.

The insulation provided by various garments and assemblies may be checked on thickness charts,[29] based on physical principles of dry insulation. Figure 3 (p. 194) analyses a cold-weather assembly; each bar represents a magnified view of the radius of clothing plus the included still air from one part of the body. Relative thermal values of the individual garments as they affect local insulation can be read simply and quickly.

The specific insulation properties of garments can be evaluated by placing them on the "copper man," a laboratory instrument of normal human size and configuration, which simulates normal body temperature and indicates heat loss for the body as a whole or for any part. By use of the copper man and the thickness charts a master chart can be prepared showing the temperature ranges for which various garments provide adequate protection. This is an important tool for determining Clothing Requirement Areas (see below).

Garments fit together on the body in layers. "Layer" is a more meaningful term than "clo," but the two units are roughly equivalent in insulation value. A standard layer is a thickness of clothing of about a quarter of an inch over the entire body. The layer system forms the basis of the Army's clothing scheme. Layers are added or subtracted according to climatic conditions and/or levels of activity. One garment approximates a half layer, two garments a whole layer. An ordinary woolen street suit represents about one layer. If care is taken with thermal balance over the entire body, garment values can be readily added up into assemblies, in intervals of a half layer, from a half layer to four layers.

Clearly, when we know the expected level of activity and the thermal properties of clothing materials and assemblies, we are well on the way to

[29] These were prepared by the Environmental Protection Section, OQMG: Charts for Correlation of Climate, Clothing and Man, 1945.

determining clothing requirements. The next need is for an adequate picture of the thermal conditions of the environment to which the individual will be exposed. Temperature is the main criterion for determining the regional distribution of clothing requirements, and under cold conditions it is the minimum temperature, especially when accompanied by high wind velocity and during least activity, which calls for the greatest protection.

Other environmental aspects may necessitate important modifications to the requirements resulting from thermal considerations. Some of the more important follow:

Terrain: Water depth; mud depth; wet-snow depth; dry-snow depth; rough ice; glare ice; gravel; sand; swamp; sod; hard earth; smooth type rock; loose type rock; ground-water level; alternate freezing and thawing of ground.

Vegetation: Snagging and catching; types of camouflage; mold and fungus; growths impeding maneuverability; noxious plants.

Insect and animal: Stinging types; biting types; disease-bearing types.

Blown particles: Salt spray; dust; sand

Factors affecting the eyes: Ground glare; snow glare; glare from water and low clouds; wind-blown material.

Clothing has certain important functional aspects, which must also be taken into consideration. The following, for example, are always important and may at times be absolutely essential: lack of restriction, so that work can be done with the minimum of physical and mental effort; freedom of use for the hands; distribution of pockets, loops, and the like to afford maximum usefulness; avoidance of projections and loose flaps, which may increase wind resistance and interfere with efficiency; design of openings and fastenings for ease and reliability of use under expected environmental conditions.

Although it may sometimes be necessary to develop special materials, the utilization of existing supplies will always be a matter for consideration. Social customs and accepted fashions must also be taken into account.

PREPARATION AND USE OF THE ALMANAC

The clothing almanac shows by use of double-entry tables the item-by-item and month-by-month clothing requirements of a specific region known as a Clothing Almanac Region. The region is arbitrarily chosen (e.g. Japan, United States) and may include parts of one or more Clothing Allowance Zones (Fig. 1), which must be functionally subdivided into Clothing Requirement Areas (Fig. 6) since the temperature of any given month may vary considerably from place to place within a Clothing Allowance Zone. This means that all Clothing Requirement Areas within the same Clothing

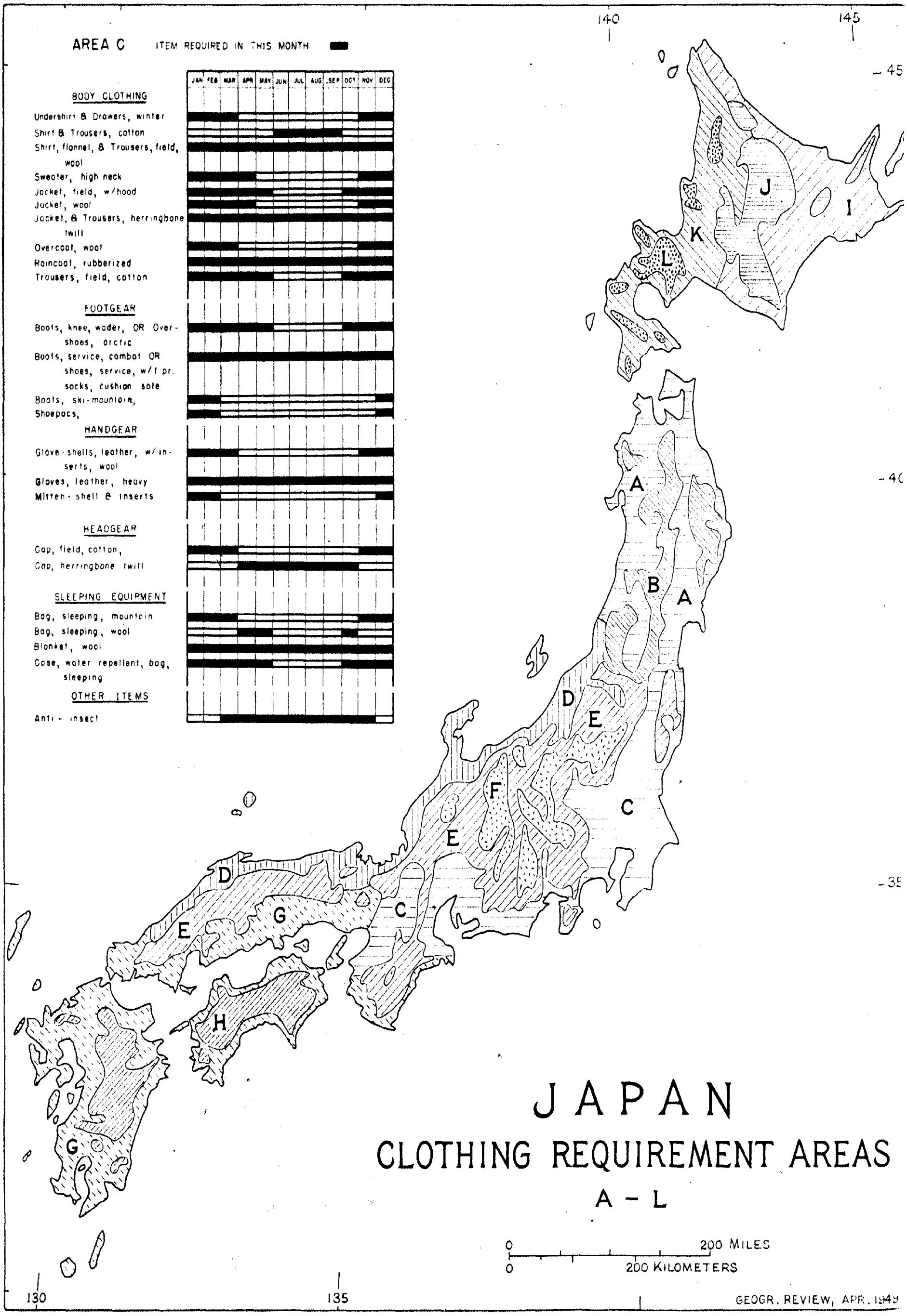

FIG. 6—*a*. Clothing Requirement Areas of Japan. These are based on a World Clothing Allowance Zone system (Fig. 1).
b. Clothing Requirement list for Area C.

Allowance Zone will have the same basic or annual clothing allowances but will differ in monthly requirements. For example, the annual clothing allowance for southern Japan is the same throughout since it falls in Temperate Zone number one (Fig. 1). Monthly requirements for part of that area vary, however, and are set forth in the almanac on check lists (Fig. 6).

Clothing Requirement Areas are based on the system employed with the Climatic Zone Maps (see p. 191 and the accompanying separate maps). A given area has the same sequence of average monthly climate throughout (with certain adjustments of boundaries) and hence of clothing requirements for all 12 months of the year. Mountains present many problems and require special delineation with much simplification. For the purpose standard climatological techniques using lapse rates are employed for delimiting the Allowance Zones and the Requirement Areas. Within each prescribed mountain zone are three subdivisions showing the changes of climate and clothing requirements with increase in elevation.

As mentioned previously, one standard layer gives a man adequate environmental protection, under the conditions prescribed, for each range of temperature of 18° F. It is apparent, then, that one layer suffices for the Warm Zone, two for the Mild Zone, three for the Cool Zone, and four for the Cold Zone. Employing this rule and matching the ranges of capabilities of individual clothing items (as given on a prepared Master Chart) with average monthly climates, the clothing requirements, item by item and month by month, can readily be determined and set down on check lists for the almanac. Subjective judgment, of course, must be exercised in the process to assure that as many of the variables as possible are met—environmental, human, and clothing. The net result, then, is a clothing almanac containing (*a*) a map showing the location of the several Clothing Requirement Areas and (*b*) a special check list showing the requirements for individual clothing items for each month and for each area (Fig. 6). A solid bar on the check list opposite an item shows that its use is mandatory during the period indicated; a broken bar indicates optional use.

By use of the almanac the clothing requirements for one man or a thousand men can be worked out simply and quickly by a person who knows nothing of techniques of almanac construction. Thus, the almanac insures adequate bodily protection from environmental conditions and promotes efficiency of supply.

Further Developments Needed

During the war rather arbitrary use was made of the concepts already discussed, as of many other ideas; but with a return to the free operation of

natural laws, normal development must be expected. As often happens, brief experience in applying these new concepts to practical problems revealed deficiencies of information required for their proper utilization. In some cases the type of information is comparatively new, but in others the new need merely accentuates what has long been recognized as a deficiency.

IMPROVEMENT OF CLIMATIC DATA

Among climatological deficiencies is one which is particularly exasperating physiologically. From man, as from other warm-blooded animals, evaporation takes place from a surface of relatively constant temperature. Experience has shown that this evaporation is largely determined by the vapor pressure (or, within the usual limits of error, by the absolute humidity). Now published meteorological data abound in figures of relative humidity. To obtain most of these, simultaneous readings must have been made of dry- and wet-bulb thermometers, yet seldom is the associated temperature given. Sometimes an approximation of the corresponding vapor pressure can be essayed, but often nothing short of a sheer guess is possible. There is here, then, a need for twofold action: to extract from the meteorological archives, where possible, the additional information needed to obtain vapor pressures, and to ensure that meteorological data published in the future will indicate the temperatures coincidental with relative humidities. If those responsible for assembling such material for publication like to go further and include vapor pressure, absolute humidity, or dew point, no animal climatologist will be heard to protest!

Records of the incidence of solar radiation are not overplentiful in the Northern Hemisphere; in the Southern Hemisphere they are rare. For physiological purposes average receipts over periods of not less than half an hour are more useful than a tracing of momentary fluctuations. This, the cost of the instruments employed, and the time required of the observer determine the type of instrument that can be set up to obtain regular observations at a large number of stations. Standard pyroheliometers are unsuitable on two counts; thermopiles, even the convenient and low-priced G. E. Radiation Meter DW-60, are also unsuitable, since they can be used only for spot readings. One of us (Lee) has proposed an adaptation of the Vernon-Bedford globe thermometer for this purpose, but possibly more compact forms of black-body recorder could be developed.

When considering man on a global scale, one is apt to see him only through strategic glasses; but the man himself is usually much more concerned with his role as a tactical unit. Variations from the climatic conditions

indicated by the usual meteorological data must be considered. These are of two kinds—statistical variation at the recording station[30] and locational or microclimatic variation. As regards the former, published data are all too frequently silent. As regards the latter, basic principles are gradually being established by which the probable variation can be determined from a knowledge of the exact topography; but it is already evident that the chances of discrepancy are large, and, when possible, the final appeal will always be to local knowledge. There is obvious need for the improvement of recorded statistical information on variation of conditions at meteorological stations, further development of microclimatic determinants, and wider compendiums of local records.

FORMULAE FOR THE THERMAL ASSESSMENT OF ENVIRONMENTAL CONDITIONS

Since the beginning of the nineteenth century it has been realized that temperature alone is insufficient to describe the significance of atmospheric conditions for man. Hill[31] attempted to overcome this lack with his katathermometer, but it proved inadequate. Since then attempts have, for the most part, followed one of two lines: the designing of thermometric instruments that conform more closely to the human body, and the systematic recording of purely empirical assessments. Bazett and Burton have suggested[32] what would appear to be the ultimate in the first category; the American Society of Heating and Ventilating Engineers has developed the "effective temperature" scheme, the most useful system of empirical assessment. Plummer, working for the Environmental Protection Section of the OQMG, has designed a "rigorograph"[33] which is much simpler than Bazett's instrument and which, when used in wet and dry parallel, gives a measure of the combined effect of all four major variables. The Climatic Research Laboratory OQMG has perfected the "copper man"[34] (originated by the workers of the Pierce Laboratory) by means of which heat exchange with the environment through radiation and conduction-convection can be measured and the effects of different clothing assemblies compared.

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[30] Some aspects of this were discussed by Arnold Court at the Annual Meeting of the Association of American Geographers, Charlottesville, Va., Dec. 28, 1947.

[31] L. Hill and others: Measurement of the Rate of Heat Loss at Body Temperature by Convection, Radiation and Evaporation, *Philos. Trans. Royal Soc. of London*, Ser. B, Vol. 207, 1916, pp. 183–220; and D. Hargood-Ash and others: The Kata-thermometer in Studies of Body Heat and Efficiency, *Medical Research Council, Special Rept. Ser. No. 73*, 1923.

[32] Private communication.

[33] Report not yet published.

[34] J. E. Fitzgerald: A Study of the Copper Man, Phase I: Physical Characteristics, Thermometry, Air Clo Evaluations, Climatic Research Laboratory, OQMG, 1946.

These approaches, however, are self-limited; they give useful information about a particular situation or problem, but they are not easily applicable to general climatic considerations. The "effective temperature" scheme[35] has certain faults, recently pointed out by Yaglou, that could be corrected by further experimentation of the kind being done by Keeton, Glickman, and others at the University of Illinois Medical School. But it applies only to sedentary workers, clothed in one of two fashions, and does not cover the cold zones. The workers of the Environmental Protection Section during the war developed the idea of expressing the significance of an environment thermodynamically from considerations of body heat production, known laws of heat exchange, and meteorological data. These ideas are being extended and represent one line of needed future development.[36]

DETERMINATION OF THE PHYSICAL PROPERTIES OF FABRICS

It is obvious that, if the quantitative approach as illustrated by Burton's equation is to be followed, resistance to heat flow, to the passage of water vapor, and to movement in the ambient air must be determined for all fabrics. So far, only a few have been adequately investigated. In addition to these directly thermal properties, others need to be known, such as the rate and extent of water uptake and the thickness of effectively dead air contained under different degrees of compression. The methods have been fairly well standardized; their application requires extension.

CLOTHING ASSEMBLIES AND THEIR IMPROVEMENT

Environmental protection is only one of the requirements of clothing. Durability, convenience in terms of the wearer's occupation, esthetic satisfaction, weight, and, for combat purposes, concealment may all be of equal or even greater importance. And above all these, at least for the private consumer, looms the manufacturing and distributing cost. To the designer, or clothing engineer, falls the unenviable task of finding a compromise between these frequently conflicting claims. It is doubtful whether the full significance of the newer knowledge of clothing in relation to environmental protection has yet been adequately considered by the designer for any wide range of garments, and it is for this reason that closer cooperation between the physicist, the physiologist, and the designer is imperative in the near

[35] American Society of Heating and Ventilating Engineers, Guide, New York, 1947.

[36] D. H. K. Lee: Human Response to Heat and Cold, *Heating, Piping and Air Conditioning*, Vol. 20, No. 9, 1948, pp. 133–135.

future. It should be emphasized that this cooperation must take place in connection with the designing of proposed garments and assemblies, since the thermal properties of fabrics can be considerably modified by details of design.

In the interest of economy at least, it is desirable to know in what way assemblies meet or depart from the thermal requirements which they were designed to fill. Designs produced by long years of hard experience must have good points, which may well be incorporated in the "new look." Many, however, have points whose only claim to perpetuation is antiquity, just as certain obvious faults in the design of domestic fireplaces in England perpetuated for more than a century were recognized only when acute fuel shortage forced a scientific investigation of efficiency.

Appendix I—Acknowledgments

The work of a large number of scientists has been drawn on in gathering the material used here. Most of this work originally appeared in the form of duplicated reports to service organizations; and although some of it has since been published in the regular scientific journals, other parts, including certain basic presentations, remain in obscurity. A full list of references would occupy many pages. The authors have adopted the principle of citing, by preference, articles that are generally accessible and referring to service documents only when adequate accounts have not appeared elsewhere. Anyone desirous of pursuing a more detailed study could start from the general accounts, such as those found in Newburgh and Harris' "Clothing Test Methods" or in the *Annual Review of Physiology*.

To the workers of the Aviation Medical Research Committee of Canada, the Clothing Subcommittee of the OSRD Committee on Aviation Medicine, and the Environmental Protection Section of the OQMG (and its progenitors, particularly Dr. Paul Siple, chief of the section from its inception in 1942 until 1946, who inspired many of the basic developments), and to many others whose scattered contributions contributed significantly to our stock pile of knowledge, the authors are deeply indebted, and they express the hope that this review will do something to bring their efforts to full fruition.

HOW HOT IS DEATH VALLEY?*

ARNOLD COURT

DEATH VALLEY, California, is known generally as the hottest place in North America at which temperatures are recorded officially. On July 10, 1913, the extreme temperature of 134° F. was recorded there.[1] Little is known, however, of the conditions that prevailed at the time this record was established or, more important, of the probability that it will be equaled or broken. On how many other times has the temperature in Death Valley exceeded 130° F. or 125° F.?

Death Valley is a faulted valley in the northern part of the Mojave Desert of southeastern California about 200 miles northeast of Los Angeles. It is 140 miles long from north to south but only 6 to 15 miles wide. On the west the Panamints rise to 6000–11,000 feet; on the east are the Grapevine, Funeral, and Black Mountains, 4000 to 8000 feet; lower mountains close the ends.[2]

A transverse range of low hills divides Death Valley into two basins. In the southern basin are the salt beds, the lowest point of which—and the lowest point in North America—is 280 feet below sea level. The best water source in the valley is Furnace Creek, which issues (at a temperature of 70° F. the year round) from springs in the Funeral Mountains, near the middle of the valley. A ranch was started in 1870 at the mouth of Furnace Canyon; later, renamed Greenland Ranch, it became the headquarters of the Pacific Coast Borax Company.

OBSERVATIONS

Weather observations began on April 30, 1891, when a temporary Weather Bureau station was set up near Furnace Creek as part of a general governmental investigation of Death Valley.[3] Observations were continued without a break for five months, in the hottest part of the year; they showed

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*Revised from *Memorandum Report No. 38* of the Environmental Protection Section, Research and Development Branch, Military Planning Division, Office of The Quartermaster General, Department of the Army. Published by permission. The encouragement of Dr. Hoyt Lemons is acknowledged gratefully, and also the assistance of Mr. Owen S. Parmele in making tabulations.

[1] G. H. Willson: The Hottest Region in the United States, *Monthly Weather Rev.*, Vol. 43, 1915, pp. 278–280; reference on p. 279.

[2] A succinct and well-illustrated account of the region is found in "Death Valley: A Guide," written and compiled by the Federal Writers' Project of the Works Progress Administration of Northern California (American Guide Ser.), Boston, 1939, pp. 3–23.

[3] M. W. Harrington: Notes on the Climate and Meteorology of Death Valley, California, *U. S. Weather Bur. Bull. No. 1*, 1892.

➤ MR. COURT was meteorologist at Little America, U. S. Antarctic Service Expedition 1939–1941; served as weather officer in Alaska (co-author with David Bruce of "Trees for the Aleutians," *Geogr. Rev.*, July, 1945); and now heads the Climatology Unit, OQMG.

an absolute maximum temperature of 122° F., an average July temperature of 102° F., and 1.40 inches of rain from 22 showers, the only complete record to date of the frequency of showers in Death Valley.

In 1911 a cooperative station of the Weather Bureau was established at Greenland Ranch, 178 feet below sea level, observations to be taken by the foreman of the ranch.[4] Once a day since June of that year, with few exceptions, readings have been made of two thermometers, maximum and minimum. The thermometers are housed in a regulation Weather Bureau thermometer shelter erected in a fenced-off level plot. "The instrument shelter was moved 40 feet west of its former location in the latter part of 1937 due to relocation of the highway. Nothing in the record indicates any other movement of the instrument shelter."[5]

Although the ground within the enclosure is typical desert soil, the adjacent land seems to have been under irrigation at various times. It is probable that on many days the temperature at Badwater, at the bottom of the valley, 280 feet below sea level, is higher than at Greenland Ranch, but it is doubtful whether the extreme temperatures there differ much from those at the ranch.

Death Valley National Monument was created in February, 1933 (extended in 1937),[6] and on November 21, 1934, a cooperative weather observing station was set up at the monument headquarters at Cow Creek, 152 feet below sea level, four miles north of Greenland Ranch and 26 feet higher. The thermometer shelter is over typical desert ground, with no irrigation near by.

Temperatures

Except for the five months of observations in 1891, the only temperature data for Death Valley are the daily maximum and minimum temperatures at Greenland Ranch since 1911 and at Cow Creek since 1934. Monthly averages and extremes of these temperatures are published by the Weather Bureau in its "Climatological Data," California Section, and also daily temperatures at Greenland Ranch since 1938. Daily temperatures at both stations since their establishment are available on the original observation sheets (Weather Bureau form 1009), filed in the National Archives.

Over the 13-year period 1935–1947, mean July temperatures at Cow

[4] Willson, *loc. cit.;* A. H. Palmer: Death Valley—The Hottest Known Region, *Monthly Weather Rev.*, Vol. 50, 1922, pp. 10–13, reference on p. 11.

E. E. Eklund: Some Additional Facts about the Climate of Death Valley, Calif., *Monthly Weather Rev.*, Vol. 61, 1933, pp. 33–35.

[5] Letter, dated April 28, 1948, from A. W. Anderson, acting regional director, U. S. Weather Bureau, Los Angeles, Calif.

[6] "Death Valley National Monument," U. S. Dept. of the Interior, National Park Service, 1947.

Creek average 0.9° F. higher than at Greenland Ranch. However, the temperature variability at both places is such that statistical analysis finds one chance in six that the difference is accidental, and it therefore is not very significant. Similarly, the extreme variation from year to year in the hottest temperatures for July at both places makes relatively unimportant the apparent difference of 1.2° F. between the averages of these values; statistically, there is one chance in seven that such a difference could be accidental.

Temperatures at Greenland Ranch have not exceeded 127° F. except in 1913, the year when the record of 134° F. was set. In that year the temperature reached 127° F. on eight consecutive July days:

Date	7	8	9	10	11	12	13	14
High	127	128	129	134	129	130	131	127
Low	89	90	93	85	85	85	85	96

TABLE I—AVERAGE AND EXTREME TEMPERATURES AT GREENLAND RANCH*

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Avg. Max.	66	72	81	90	99	109	116	114	106	91	76	66	91
Avg. Min.	38	44	51	60	69	78	87	84	73	59	46	39	61
Average	52	58	66	75	84	94	102	99	89	75	61	52	76
Highest	85	92	100	109	120	124	134	127	121	110	93	86	134
Lowest	15	21	30	35	42	49	62	65	41	32	24	19	15

*M. K. Bankert: Weather in Death Valley, *on* verso of the U. S. Weather Bureau's Daily Weather Map for July 25, 1947.

TABLE II—COMPARISON OF JULY TEMPERATURES (°F.) IN DEATH VALLEY

G.R.: Greenland Ranch (Furnace Creek), −178 ft. m.s.l.
C.C.: Cow Creek (Monument Headquarters), −152 ft. m.s.l.

YEAR	AVERAGE		HIGHEST (*date*)		LOWEST (*date*)	
July	*G.R.*	*C.C.*	*G.R.*	*C.C.*	*G.R.*	*C.C.*
1935	99.3	100.6	121 (13)	123 (13)	76 (2*)	76 (2)
1936	102.2	102.4	125 (17*)	124 (16*)	76 (11*)	69 (11)
1937	102.7	101.6	123 (4*)	124 (3)	82 (13*)	79 (20)
1938	100.2	101.9	120 (19)	125 (21)	68 (26)	76 (26)
1939	100.6	101.5	123 (13)	122 (13*)	78 (7)	78 (29)
1940	100.0	100.4	123 (24)	123 (24)	71 (21)	75 (21)
1941	100.3	101.2	124 (22)	124 (22)	78 (16*)	77 (29*)
1942	105.0	104.4	125 (24)	126 (24)	80 (19*)	83 (19)
1943	101.1	101.8	124 (26*)	124 (27)	79 (2)	78 (2)
1944	97.6	98.8	120 (1*)	120 (1)	74 (12*)	79 (10)
1945	101.0	103.9	123 (26)	125 (26)	74 (9)	80 (9)
1946	98.8	100.0	118 (11)	119 (27)	71 (21)	78 (21)
1947	100.6	102.3	122 (19)	126 (19)	81 (7)	80 (11)
Avg.	100.7	101.6	122.4	123.6	76.0	77.5

*Also on later dates.

The maximum thermometer in use during the hot weather of July, 1913, was graduated only up to 135° F., and in a note accompanying his report at the close of the month the observer stated that he doubted whether the record was high enough "because other ordinary thermometers at the ranch showed a much higher temperature." It is common for thermometers on the walls of buildings, unprotected from sunshine and ground radiation, to read much higher than instruments properly exposed in shelters. In none of the reports concerning this record temperature is there any indication that the thermometer was subsequently checked or recalibrated.

Willson,[7] district forecaster at San Francisco, studied the daily weather maps without finding any "peculiarity that would explain the extremely hot weather in Death Valley in July, 1913." "The weather type was that which always causes high temperatures over the south Pacific coast district, it was not unusually pronounced, and did not give record temperatures in any other portion of California." On that day, the borax company superintendent said: "It was blowing very hard . . . a man perished in the valley north of the ranch." Henry ascribed the very high temperature to adiabetic warming of air previously heated in the Nevada desert, 6000 feet higher, to more than 100° F.

In 1913 sunspots, an index of solar activity, were at a minimum;[8] the only spots observed during the entire summer appeared from July 9 to 14 inclusive and on August 23. Since any sudden outburst of solar energy would affect large areas of the earth at once, and since no unusual temperatures were reported elsewhere, the occurrence of very high temperatures in Death Valley in this sunspot period must be classed as fortuitous.

Although it is possible that the very high readings were due to a short-lived bubble in the maximum thermometer or to blackening of the instrument shelter through exposure, there is no indication that the readings as reported are not correct. The maximum reading of 134° F. is accepted as official by the Weather Bureau, even though it is 7° higher than the hottest temperature in any other of the 36 years of record. Hellmann[9] suggested that the record should have been reduced to 133° F because of probable radiative heating from the ground, although Willson had emphasized that "the shelter is not exposed to the reflected heat of the desert." Hellmann also

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[7] Willson, *loc. cit.*

[8] A. Wolfer: Provisorische Sonnenflecken-Relativzahlen für das dritte Quartal 1913, *Meteorol. Zeitschr.*, Vol. 30, 1913, p. 501.

[9] G. Hellmann: Grenzwerte der Klimaelemente auf der Erde, *Sitzungsber. Preuss. Akad. der Wiss., Phys.-mathem. Klasse*, 1925, pp. 200–215. Cited by Mark Jefferson: Limiting Values of Temperature and Rainfall Over the World, *Geogr. Rev.*, Vol. 16, 1926, pp. 324–326; reference on p. 324.

AVERAGE FREQUENCY OF DAILY EXTREME TEMPERATURES AT GREENLAND RANCH, DEATH VALLEY, CALIFORNIA IN JULY (1911-1947)

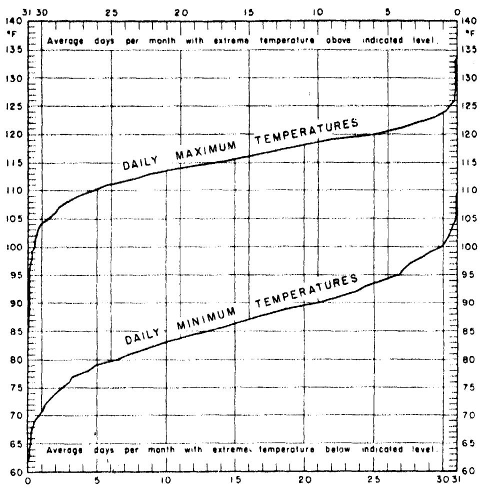

FIG. 1

considered unreliable the new world record of 58° C. (136.4° F.) claimed for Azizia, Tripoli, on September 13, 1922, because maxima at four near-by stations were 10 C° lower that day.

Frequencies

Of greater significance than the hottest temperature for any year or for a period of years is the frequency with which the various temperatures have occurred, day by day (Tables III and IV). This is illustrated in Figure 1. From the graph can be determined the average number of days in a month on which the minimum or maximum temperature is likely to be above or below any given temperature. It can be seen that, in an average July at Greenland Ranch, on 17 days the temperature will reach 115° or higher, on six days it will go to 120° or higher, and on only one day will it reach 124° or higher. On only one day a month will the temperature sink to 71° or lower, on seven days to 80° or lower, and on 13 days to 85° or lower. On one day a month the temperature will not exceed 104°, and on one day it will remain at 100° or higher. If the maximum daily temperatures were normally distributed (they are skewed markedly toward lower temperatures), a value of 134° F. or higher would occur about once in 806 days, or 26 Julys. However, analysis of the 37 yearly maxima according to Gumbel's[10] theory of extreme values shows the expectancy of an extreme of 134° F. or higher to be about once in 650 years.

Temperatures recorded at Death Valley and other official weather observing stations are for the air at five feet or more above the ground. Below this level, the air on hot days is usually much hotter. Records from Africa show that the surface of desert sand or gravel may approach 180° F.,[11] and the air

[10] E. J. Gumbel: On the Frequency Distribution of Extreme Values in Meteorological Data, *Bull. Amer. Meteorol. Soc.*, Vol. 23, 1942, pp. 95–105; The Statistical Forecast of Floods, Ohio Water Resources Board, Columbus, 1948.

[11] C. E. P. Brooks: Climate and the Deterioration of Materials, *Quart. Journ. Royal Meteorol. Soc.*, Vol. 72, 1946, pp. 87–97; reference on p. 88.

TABLE III--FREQUENCIES OF DAILY MAXIMUM TEMPERATURES IN JULY AT GREENLAND RANCH, DEATH VALLEY, CALIFORNIA

°F	1911	12	13	14	15	16	17	18	19	20	21	22*	23	24	25	26	27	28	29	30*	31	32	33	34*	35	36	37	38	39	40	41	42	43	44	45	46	47	Total	Average
134			1																																				1	.03
133																																								
132																																								
131			1																																				1	.03
130			1																																				1	.03
129			2																																				2	.06
128			1																																				1	.03
127			2			1																	2																5	.15
126			1			1						1									2		1																5	.15
125			1			1	1			1		2				1	1	1					2	2		2						1							12	.36
124			1			1	5			1		3		1	3		1	2					5	1							1	1	2						24	.72
123						1	7			1	2	3	1	1	1		4	4	3		6		1	1		4	2		4	1		1			1				45	1.35
122	1			1		3	5		1			2		3	3	2	1	1	4	1	3		3			4	2			1		2	1		1			1	43	1.29
121	1		1			1	5		2	2	1	3	2	1	1	2	3	4	5	1	4	1	3	3	1	3	2		2	3	1	2	3						56	1.67
120	4			5	1	4	6	2	5	5	7	1	1	3	5	1	4	6	8	5	7	2	1	1	1	2	3	1	3	1	3	3	2	2	3			1	102	3.05
119	4		2	3	1	2	2	1	2	1	2		2	1	2	4	3	2	5	1	3	6	1	3	1		4	1	3	2	4	2	1	1	2			1	71	2.12
118	4	1	2	4	4	1		1	5	1	2	2	2	4	2	5	4		2	4		3	1	4	2	3		1	2		2	3	3	1	4	1	2	71	2.12
117	4	3	1		2	2			2	1	2	1	3	2	1	2	3			4	3		2	1	1		1	1		3		6	1	2	4	2	4	58	1.79
116	2	1		6	4	4		2	2	3	2	3		1	2	4	2			2	1	3	4	3			1	3	2	2	3	1	2		7	6	4	74	2.21
115	5	4		8	6	3		5	2	4	3	4	2	2	3	2	3	3	1	1	2		1	3	3	1	5	5	1	3	2	4	1	4	4	5	2	99	2.96
114	2	2		1	5	1		1	4		1	4	2	6		2		1	2	4		6	1	2	2	2		2	3	2	1	2	4	5		4	3	67	2.00
113		1			1				1		2	1	7	1	1	1		1		2		1		3	1		4	1		5	2		3	5		5	4	47	1.41
112	2	3		2	2	3			1	1	2	1	5	4	1	1	1	1		2		3		1	3	1			2	2	5		2	3	3	3	4	60	1.79
111		3	2		1			2					1	1	1		1			2		1	1	1	1	1	3		1			1	2	5	1	3	1	33	.99
110	1	1			3	1		7	1	4	1		1					3		2		1	1	1		1	1		1	2	1	1	2		1	1	3	39	1.17
109		4		1	1				1				1		1	1			1				1		5	2	1		1		1			2				24	.72
108		3	4					1	1	1					1	1						2			1		1	1		1	1			1				20	.60
107		1	1												1										3		1		2	1								10	.30
106			1					1	1															1	3	1		1	3	1						1	1	14	.42
105			2					4		5	1							1							1			2			2		2					20	.60
104			1												1							1				1			1	1	1							7	.21
103		1											1		1	1												1										5	.15
102		1																																				1	.03
101																												1										1	.03
100		1	1					1			2														1						1							7	.21
99																						1																1	.03
98			1																						1	2												4	.12
97																										1												1	.03
96		1																																				1	.03
95								1																														1	.03
94																																							
93																																							
92																																							
91																																							
90																																							
89																																							
88																1																						1	.03
87																																							
86																																							
85								1																														1	.03

* Data missing or incomplete, not used in summary.

TABLE IV--FREQUENCIES OF DAILY MINIMUM TEMPERATURES IN JULY AT GREENLAND RANCH, DEATH VALLEY, CALIFORNIA

°F	Year 1911	12	13	14	15	16	17	18	19	20	21	22*	23	24	25	26	27	28	29	30*	31	32	33	34*	35	36	37	38	39	40	41	42	43	44	45	46	47	Total	Average
110								1																														1	.03
109																																							
108																																							
107																																							
106																																							
105							1			1	7					1																						10	.30
104											2																											2	.06
103					1	1					1				2																							5	.15
102																		1					4			2	1											8	.24
101				1	1								1		1			3					1			1												9	.27
100					4		2	1			2			1	1		11	3	1		2		3										1					32	.97
99					4	1					1			1			3		2	1	1			1	2	1						2						18	.54
98					6		3	1	1						1	1	2	1	2	1			3			1						5						27	.82
97					3								1				5		2				1				1				1	2						16	.48
96					1		2							1			1		1	3					1		2	2				1						12	.36
95			1	1	4	1	5		3	3			2		1			1	2	1		1		1	1	5	2	3			1	2				1		40	1.21
94			1		1	1	3		1		1		1			2			4		2	1	2		2		2	3	1	2	1	1			1	1	4	38	1.15
93			1	2			1	1		1				2	2				4	1			1	2		1		2			1	3			1			23	.69
92	1	1					2	1	3	1			1	1	1	2	1		4	1	1	3	2	1	2	1	2	3	1	2	3	4	3		1		2	49	1.48
91	2	1		3	3				3	1			1	1	1	2			6		1	1	2			2		1	1	1		1	2	1	4	1	1	43	1.30
90	2		1	3	2	6	6	3	3	6				3	1	5		1	3		3	2	1	2			2		4	3	3	2	3			1	3	72	2.17
89	1	1	2	3	1	4				1			1	6	1	1	1			2		4		1	4	1	4	1	1	2	3		2			1	1	47	1.42
88	2	1	1	1		2	1	5	1	1			1	3	3	3				1	1	1		1	3	1	3		2	1	1		2	1	5	4	1	51	1.54
87	4			4			1		1	1				3		1				3	1	2	1	1	1	2	2	2	3	1	1	1	2	2	3	3	2	44	1.33
86	3	1	2			1	2	1	1	1			1	2	1	1				2	2	1			4	1		2	1	3	2		2		3	2	3	43	1.30
85	2	1	4			2		2	5	3	4		1	2		1		1				1		2	2	3	3	1	3	4	1		4	2	1	1	5	59	1.78
84		4		2		2		3	1	2	2			1	1	1	1					2			4		3	2		2	3	1	1	6	3	2	2	51	1.54
83		1	2	3		1		1					3			1	1				4	2		1	2		1	2		4	1	2	4		1	2	1	39	1.18
82	1	2		2		1		4	2	1			2	2		1	1				1	4		2			3	1	4		1		2	3	1	2	3	44	1.33
81	3	2	2			1				1			2		1			1		1	2			2		2		1				1	1	4	1	2	2	29	.88
80	1	1		3		2	1	4	3	3	1		5	1	2	1	1	2		1	3				1			4	2	2	3	2	1	4	1			54	1.63
79	2	3		1		1			1	1	1		1		1							2								1	1		1	1	1	1		20	.60
78	4	3				2	1	2	2		1				3	1	1			1		2							1	1	3			3	1	2	1	34	1.03
77		1	2													2																		1	2	1		9	.27
76				2		1							1		1	1		1			1	2		1	2	1										1		14	.42
75		1	2					1			2		4		2		1						1							1				1		1		17	.51
74	2	1	1							1					1			1			1													2	1	1		12	.36
73		1	3							1				1	1	2		3			2																	14	.42
72	1																	2			1																	4	.12
71		1	2							1			1			1		1												1						1		9	.27
70			1								1				2			3			2		1															10	.30
69		1									2							1																				4	.12
68		1									1							2					1					1										6	.18
67		2											1																									3	.09
66																																							
65																		1																				1	.03
64											1																											1	.03
63											1							1																				2	.06
62																	1																					1	.03

* Data missing or incomplete, not used in summary.

in contact with it is almost as hot. In general, the decrease of air temperature upward from the surface is logarithmic.[12]

The following temperatures at various heights are cited by Ives[13] as typical conditions, apparently on the Utah desert, favorable for the formation of dust devils: surface temperature, 160° F.; one foot above surface, 142°; five feet, 116°; 500 feet, 100°; 2000 feet, 92°. The first three temperatures were measured with a polished fine-wire thermocouple, the last two with a slip-stream thermometer. A similar temperature distribution is reported by Williams[14] for the open desert at Inyokern, Calif., 70 miles west of Death Valley.

Although an extreme temperature of 134° F. has been officially recorded in Death Valley, in no other July in 37 years of record has the temperature there exceeded 127° F. The likelihood that any day in July will have a maximum temperature higher than 125° F. is only one in 200; i.e. one day in about seven summers. The following distribution may be taken as the maximum to be expected, except for a negligible part of the time, in Death Valley and in the North American deserts generally: air at five feet, 125° F.; at one foot, 150° F.; at one inch, 165° F.; at surface of ground, 180° F.

Constantly increasing accuracy in weather observations and higher standards of instrument exposure make it seem probable that no future official observation will exceed the present high temperature record for North America now held by Death Valley.

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[12] W. A. Baum: Temperature Surrounding the Soldier, *Rept. No. 124*, Part III, Environmental Protection Section, Office of The Quartermaster General. (In preparation.)

[13] R. L. Ives: Behavior of Dust Devils, *Bull. Amer. Meteorol. Soc.*, Vol. 28, 1947, pp. 168–174; reference on p. 170.

[14] N. R. Williams: Development of Dust Whirls and Similar Small-Scale Vortices, *Bull. Amer. Meteorol. Soc.*, Vol. 29, 1948, pp. 106–117; reference on p. 116.

DESERT CONTRASTS

ILLUSTRATED BY THE COACHELLA

ROBERT M. GLENDINNING

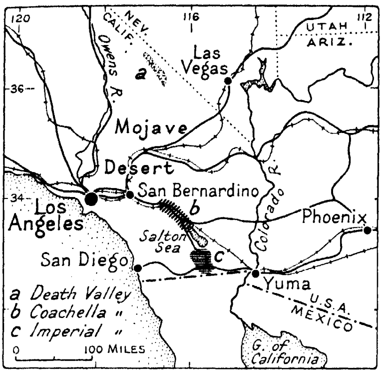


FIG. 1—Setting of the Coachella.

DESERT regions are commonly described in terms of "monotony," "sameness," "uniformity of expression," or "little variety because of extreme aridity." These are descriptions given by persons born and reared in humid areas. A desert dweller would seldom characterize his land thus, even the unsettled parts, though he might speak of the monotony of the rural scene in Massachusetts, the sameness of the Illinois portion of the Corn Belt, or the uniformity of expression of the northern forest region of Canada.

This discussion is a preliminary attempt to emphasize the fact that desert areas, despite many repetitive elements, have their own variety of expression, different though it may be from that of other kinds of lands; even within a single and comparatively localized area the picture is far from monotonous. The area selected is the part of the Colorado Desert known as the Coachella Valley or, more commonly and simply, as "the Coachella" (Fig. 1). Other similar illustrative areas, such as the Mojave Desert, Owens Valley, and southern Nevada, might have been selected.

The Coachella is about 90 miles east and a bit south of Los Angeles. Technically, it is not a valley but a section of the longitudinal, partly filled structural depression the lowest part of which is occupied by the Salton Sea and which includes also the Imperial Valley and the part of Mexico that lies between the Imperial Valley and the head of the Gulf of California. The Coachella is about 50 miles long and ranges in width from 10 to 20 miles or, if measured from crest to crest of the bounding mountains, 20 to 35 miles. In this larger sense the Coachella has an area of some 1200 square miles, or about the area of Rhode Island.

➤ DR. GLENDINNING, associate professor of geography at the University of California, Los Angeles, is engaged in a long-range program of Southwestern desert research. Studies have already been made of Death Valley (*Econ. Geogr.*, July, 1940) and of the Hoover Dam–Las Vegas Basin areas (*Scientific Monthly*, Sept., 1945).

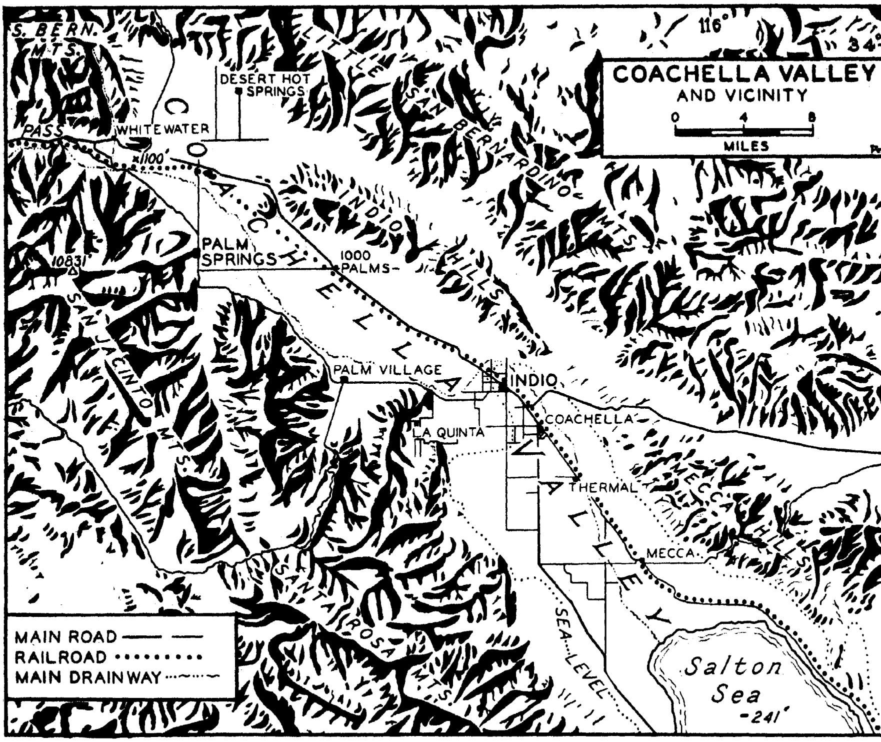


FIG. 2—General relief and location map of the Coachella Valley.

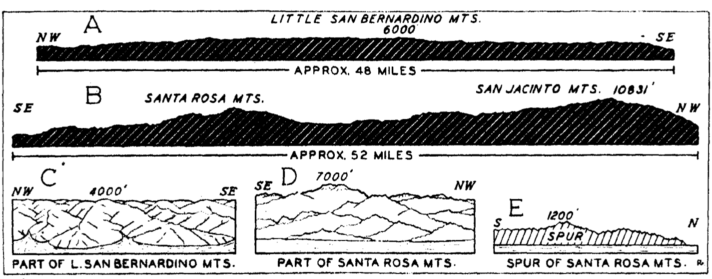


FIG. 3—Profiles and sketches from the Coachella Valley floor. A, B, D, and E are from near Indio; C is from a point southwest of Desert Hot Springs.

FIG. 4—Medium-intensity sand and dust storm, Whitewater Wash near Palm Springs.

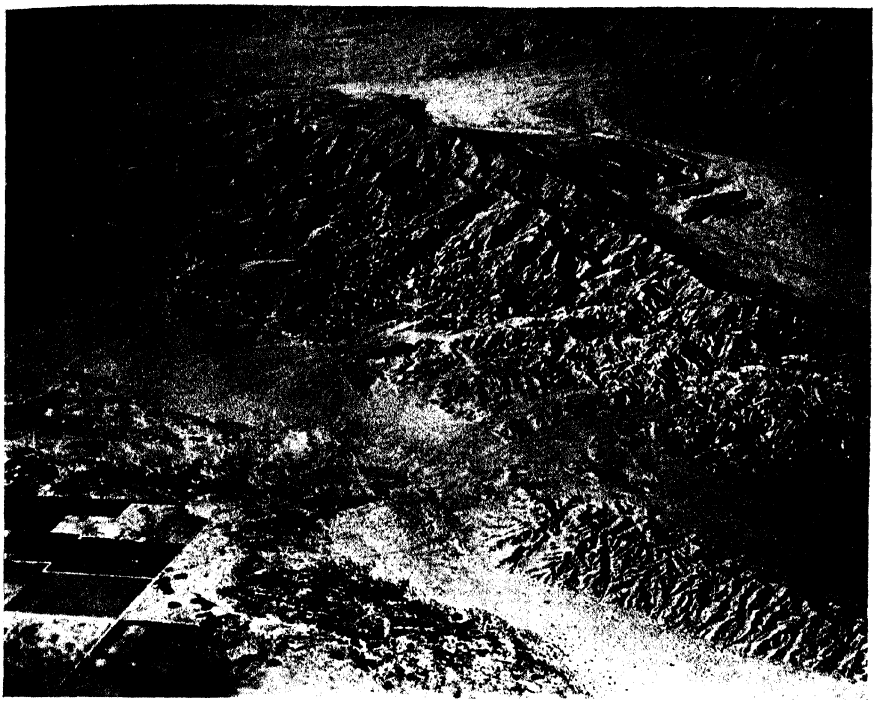


FIG. 5—Aerial view west of north from slightly east of Indio, foothills of the Little San Bernardino Mountains in the background. Note prominent fault line along front of hills. (By permission of Spence Air Photos.)

FIG. 6—Mesquite-covered dunes in the sandy area near Indio.

FIG. 7—Twenty-foot tall mesquite bush in the valley floor near the Salton Sea.

Contrasts in the Borderlands

On both sides the valley floor is walled in by abruptly rising mountains or, in small part, by conspicuous hills—the Little San Bernardinos on the northeast, the San Jacinto and Santa Rosa Mountains on the southwest (Fig. 2). The Little San Bernardinos are an uplifted fault block of relatively uniform crest line the summit of which is tilted slightly toward the northwest, that is from 5000–6000 feet at the southeast to 3000–4000 feet at the northwest. The block is cut by numerous small and large canyons, from which large alluvial fans spread out to form a continuous piedmont (Fig. 3, C). The Mecca Hills, east of the town of the same name, are badlands on a somewhat grand scale; their higher elevations are about 2000 feet above the level of the Salton Sea.

The mountains on the west are much higher, and their crest lines are more jagged (Fig. 3, B and D). Mt. San Jacinto reaches 10,831 feet above sea level, or some 10,000 feet above the nearest part of the valley floor, about six miles away—an average rise of some 1600 feet in a mile. The higher peaks of the Santa Rosa Mountains range from 6000 to nearly 9000 feet above sea level. From both the San Jacinto and the Santa Rosa Mountains, bold rocky spurs, suggestive of prehistoric armored lizards, thrust northward into the valley floor (Fig. 3, E). The change in angle from valley floor to mountain slope is startlingly abrupt. It is accentuated by the absence of any appreciable talus apron. Alluvial fans are less extensive along much of this margin of the valley; deep-reaching canyons are occupied by fans, but only directly west of the north end of the Salton Sea have any number of them been built well out into the valley plain.

The ends of the Coachella Valley also are in contrast. The northwest end narrows suddenly to become San Gorgonio Pass, the narrow trough that lies between the San Jacinto Mountains and the (Big) San Bernardino Mountains (San Gorgonio Peak is 11,485 feet), into which converge the railroad, roads, and airways of the valley. The southeast end of the valley is broad and open, next to the Salton Sea. Just as San Gorgonio Pass "funnels" the routes, the Salton Sea fans them out. The railroad, a segment of the transcontinental Southern Pacific, and one highway follow the east shore to the Imperial Valley; the main highway to the Imperial Valley runs along the west side.

Physical Contrasts in the Valley Floor

For the purposes of this paper, the floor of the Coachella Valley is the area from the entrance to San Gorgonio Pass to the north end of the Salton

Sea and from the base of the Little San Bernardino Mountains to the base of the San Jacinto–Santa Rosa Mountains. At the pass end the valley floor is about 1100 feet above sea level; at the Salton Sea (present level) it is about 241 feet below sea level. The sea-level contour crosses the valley floor near Indio.

The Indio Hills, which extend for some 20 miles northwest from a point near Indio, lie out in the valley, well separated from the Little San Bernardino Mountain front. In part, they are being slowly drowned by the extensive fan piedmont of the Little San Bernardinos. On the south side a minor fan piedmont is being built out from the hills themselves. From the upper edge of this piedmont to the higher parts of the hills the altitude change is as great as 1500 feet within two miles. Particularly in the late afternoon, the badland condition of the hills stands out sharply; then they strongly resemble a laboratory relief model (Fig. 5). A cluster of minor hills extends westward from the Indio Hills. One of them, known locally as the Big Dune, is almost completely surfaced with wind-blown sand; its smoothed outline contrasts with the badland surface of the Indio Hills.

On the eastern edge the alluvial fan piedmont blankets not only the partial trough between the Little San Bernardino Mountains and the Indio Hills but also the northernmost section of the valley and the section between the Indio and Mecca Hills. A smaller fan piedmont extends along the base of the Mecca Hills.

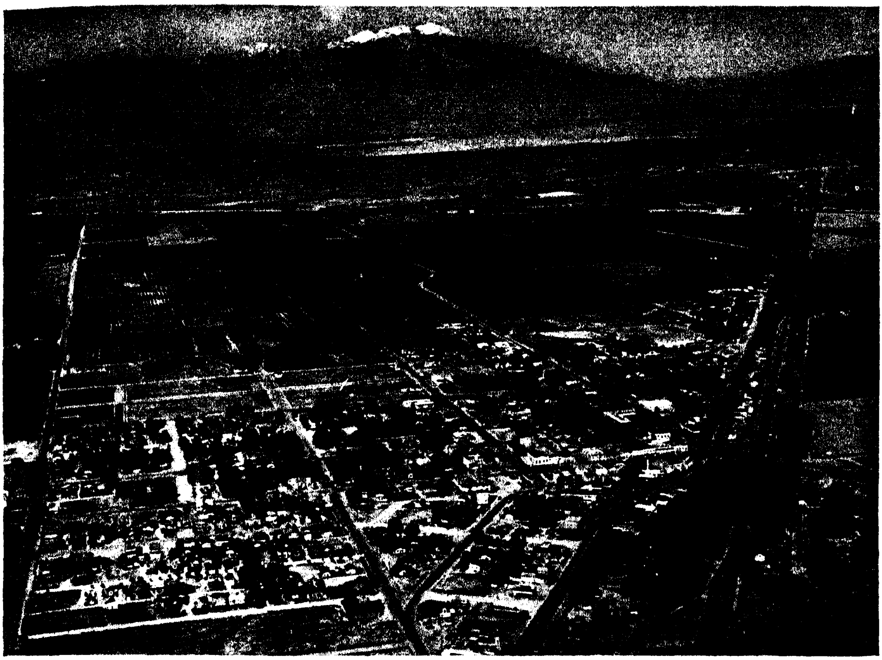
Within the more level strip that is the valley floor in the narrowest sense there are several readily discerned differences in landform expression. The part of the strip from the foot of San Gorgonio Pass to just east of Palm Springs is the braided floodway of the intermittent Whitewater River (Fig. 4). Winds of high velocity descending from the pass sweep the floodway of much of its sand and, at times, stop all travel on the north-south road between Palm Springs and the railroad. From east of Palm Springs to just south and west of Indio, the strip changes from broad floodway to an elongated area of live and dead dunes. During high winds the condition in this area is best described as a "sand and dust blizzard." Several dune types are present—veneer, knob, wave, and horseshoe-shaped dunes (these last somewhat resemble barchans, though different in origin). Dunes range in height from two or three feet (small knob dunes) to as much as 30 or 40 feet (some of the wave dunes and, particularly, the horseshoe-shaped dunes). The remainder of the strip, from Indio to the Salton Sea, contains some small areas of veneer and knob dunes, but they are not conspicuous. This is an area of extremely low relief and slowly decreasing altitude, most of it belonging to

the bed of ancient Lake Cahuilla; its grayish silt surface contrasts with both the sand-dune area and the sandy, gravelly, and, sometimes, bouldery surfaces of the fan piedmonts. Alkali becomes more and more prominent as the Salton Sea is approached, as do the beach lines of old Lake Cahuilla and the recent beach lines of the present Salton Sea.

Changes in landforms and surface materials are reflected in certain changes in natural vegetation. As is true of most deserts, vegetation is more abundant than is commonly supposed. It is difficult to find any large part that is devoid of plants, and some sections are rather thickly covered. All natural vegetation is, of course, xerophytic, and some of it, in the alkali sections near the Salton Sea, is halophytic. The fan piedmonts support heavy to sparse growths of several types of desert shrub, but creosote bush (*Larrea divaricata*) is most characteristic. The creosote bush ranges in height from two or three feet to six or eight feet. In the arroyos that mark many parts of the fan-piedmont surface are scattered palo verde trees (*Cercidium floridum*) and smoke trees (*Dalea spinosa*), which range in height from four feet to as much as 20 feet. Some cacti, mainly cholla (*Opuntia bigelorii*) and barrel cactus (*Echinocactus cylindraceus*), grow on parts of the fan piedmonts. In the lowest strip of the valley floor, vegetation changes greatly with location. The Whitewater floodway near Palm Springs is sparsely covered with wind-blown and sand-blasted shrubs. Much of the dune area supports such shrubs as mesquite, in prominent clusters (Fig. 6), and creosote bush. The horseshoe-shaped dunes, both large and small, are built around, and partly held in place by, thick mesquite brush. From the sand-dune area to the Salton Sea mesquite (*Prosopis odorata* and *P. juliflora*) is more extensive and much taller; many parts of this area are best described as patches of thorn forest or thorn scrub. The mesquite is a "water indicator," and its greater growth between Indio and the Salton Sea is a reflection of higher water table (Fig. 7). The strongly alkaline sections support thick growths of salt bush (*Atriplex lentiformis*), salt grass (*Distichlis spicata*), and, along the Salton shore, seepweed (*Dondia torreyana*.)

Thus, as in major and minor landform and soil conditions, the vegetation picture is varied rather than monotonous.

Another type of variety must be added—that in atmospheric behavior. It is epitomized by high winds and periods of extreme calm; by extremely hot summers (July average about 94° F.) and cool winters (January average about 54° F.); and by long periods of drought (average annual precipitation about three inches) broken by locally torrential rains, usually occurring in the winter months.



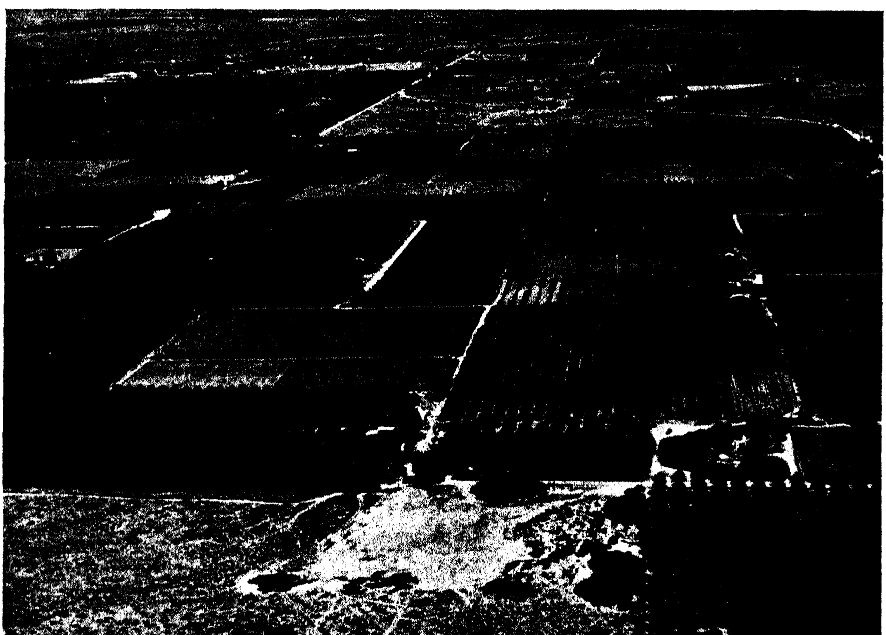


FIG. 8—Aerial view across the Coachella Valley floor to the snow-cap on Mt. San Jacinto. Town of Indio and intensively cultivated area in the foreground, raw desert beyond. (By permission of Spence Air Photos.)

FIG. 9—Aerial view of cultivated area near Indio; note contrast in foreground between raw desert and date grove. (By permission of Spence Air Photos.)

Cultural Contrasts

From San Gorgonio Pass nearly to Indio the greater part of the valley floor is "raw" desert land. But prominent in this open desert scene are the marks of recreational use. These range from full-fledged resort towns, such as Palm Springs, Desert Hot Springs, Palm Village, and La Quinta, to scattered guest ranches. Several small commercial spots are located chiefly along the main highway from San Gorgonio Pass to Indio. These, such as Whitewater and Thousand Palms, primarily serve passenger car and heavy truck traffic.

The remainder of the valley floor, except for the fan piedmont, varies markedly in appearance and land use. Extending from the vicinity of Indio almost to the Salton Sea is the highly productive oasis section that contains the bulk of the permanent population and most of the developed land. The settlement pattern is oriented to the rectangular survey rather than the valley trend, with the result that the pronounced north-south and east-west alignments of the settlement features meet the northwest-southeast natural alignments at acute angles (Fig. 2). The large and small blocks of land devoted to irrigated crops are interrupted by large and small blocks of undeveloped, raw land. The change from the one to the other is about as great as change can be—from primitive desert literally to a "Garden of Eden" (Figs. 8 and 9). The blocks of raw land reflect both natural and cultural conditions. Some of them are too sandy, too high in alkali, or too expensive to level to the degree necessary for irrigation; some are too "seepy" or marshy or do not have sufficiently developed water supply; others are being held for too high a price, are involved in litigation, or long have been set aside as Indian reservation blocks. The blocks in agricultural use exhibit considerable diversity within themselves. Chief crops are truck crops, dates, grapefruit, and grapes; others are tangerines, oranges, figs, alfalfa, and cotton. Truck crops contrast sharply in appearance with tree crops, and the "forests" of tall date palms contrast sharply with all other crops grown. Perhaps the most conspicuous contrasts within the general oasis portion of the valley floor occur where raw desert land gives way abruptly to the walled edge of the date palm groves (Fig. 9, right foreground). Thus, as in physical features, the cultural aspects contribute their own share to the desert variety.

CALIFORNIA MANUFACTURING

JAMES J. PARSONS

THE spectacular growth of California has attracted increased national attention in recent years. In the four decades before 1940 the population of the state rose from 1,485,000 to 6,907,000. Between 1940 and July 1, 1948, this phenomenal growth was accelerated as resident civilian and military population swelled a further 45.2 per cent to 10,031,000, giving California 6.9 per cent of the nation's population.[1] It has passed Ohio and Illinois in the population race and is edging closer to Pennsylvania, second most populous of the states.

Opportunities in agriculture and mining, together with a mild climate and ample elbowroom, were long the state's leading boasts and attractions. In recent years, however, they have been overshadowed as its growth and progress are measured more and more in terms of urban expansion and the increased industrial and commercial activity of the two great conurbations that occupy the Los Angeles Lowlands and the margins of San Francisco Bay. Immigration from the East, Middle West, and South, always the wellspring of California's growth, was stimulated by the wartime expansion of both private industrial facilities and military installations. A large proportion of the transient civilian workers and service personnel employed in these establishments have stayed on to become part of the permanent population.

Although the value of the goods manufactured in its factories today exceeds that of the products of its farmlands, oil fields, and mines, California is far from being an "industrialized" state. Pay-roll and employment statistics indicate that, in the state as a whole, manufacturing has lagged behind population growth. Between 1929 and 1947, comparable years of capacity production, California's share of the nation's factory pay roll (in dollars) rose from 3.8 to 5.4 per cent[2] while its population increased from 4.6 to 6.9 per cent of the national total. There was a state-wide increase in factory jobs of 71 per cent and a 74 per cent gain in population.

The percentage of a total population engaged in manufacturing—wage-earner density—offers a rough but easily managed measure of industrializa-

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[1] "Provisional Estimates of the Population of the United States, by Regions, Divisions, and States, July 1, 1948," *Current Population Repts.: Population Estimates*, Ser. P-25, No. 14, U. S. Bureau of the Census, Oct. 3, 1948.

[2] *Survey of Current Business*, September, 1948, p. 15.

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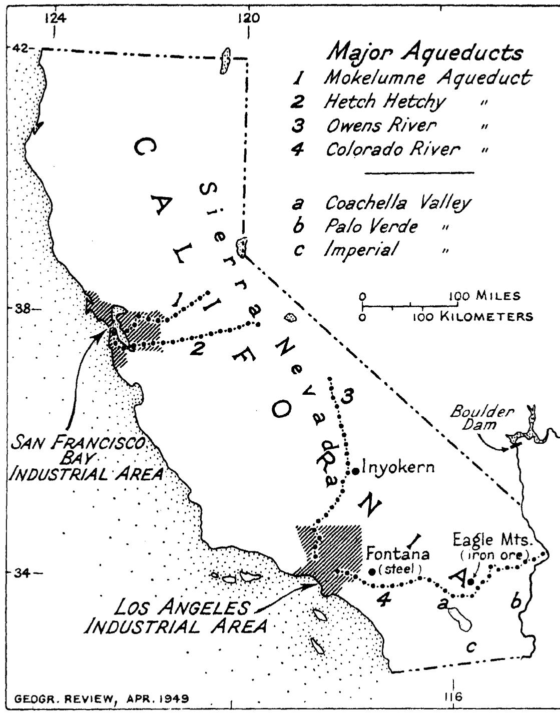

FIG. 1

tion. California's wage-earner density[3] in 1937 was 4.7 per cent, lower than that of 27 other states, including all of those east of the Mississippi River except Kentucky, Mississippi, and Florida. This figure, unchanged for the state as a whole in 1947, made its sharpest rise in the Los Angeles Industrial Area, where it increased from 4.8 to 6.2 per cent, while the San Francisco Bay Area declined from 6.7 to 6.1 per cent, reflecting its more rapid population growth rate during the war years.[4] Such figures are significantly lower than those for the industrial areas of the Eastern Manufacturing Belt, which in 1937 ranged from 8.1 per cent (New York-Newark-Jersey City) to 20.4 per cent (Reading, Pa.).

SOUTHERN CALIFORNIA

Although the meteoric rise of Los Angeles (estimated 1947 Metropolitan District population, 3,917,000), today the third city of the United States,

[3] Statistics on manufacturing wage earners for 1939 and earlier years are from a cooperative study by the U. S. Dept. of Commerce, Bureau of the Census, and the U. S. Dept. of Agriculture, Bureau of Agricultural Economics, "Changes in Distribution of Manufacturing Wage Earners, 1899-1939," prepared by H. D. Kube and R. H. Danhof, 1942, in which the census data have been adjusted for comparative use. For 1940 and later years the figures are the monthly and annual estimates compiled, by means of sampling technique, by the State of California Department of Industrial Relations, Division of Labor Statistics and Research, San Francisco, and by Bureau of the Census industrial groups. They are to be regarded as provisional pending publication of the 1947 Census of Manufactures, now in progress. Population figures, where used for comparison with factory employment, are from the nearest decennial census except that for 1947 and 1948 Census Bureau estimates have been employed. Population estimates for California counties in 1947 are the auditors' figures published in *Annual Report of the Financial Transactions of Municipalities and Counties of California for the Year 1947*, Controller's Office, Sacramento.

[4] The Los Angeles Industrial Area is conterminous with Los Angeles County. The San Francisco Bay Industrial Area comprises Alameda, Contra Costa, Marin, San Francisco, and San Mateo Counties.

has resulted in the establishment of many new residentiary industries and a few serving national markets, the city still lacks the physical aspect of an industrial center. At the turn of the century, as the great Southern California boom was getting under way, manufacturing wage earners in Los Angeles County numbered only 6600, out of a total population of 170,000. By 1947 the number of factory jobs had risen to 241,000, almost double the figure for the San Francisco Bay Area and representing nearly one-half of the state's pay roll. This does not include the motion-picture industry, omitted from manufacturing statistics, which in 1947 employed an average of 18,400 production workers in the Hollywood area.

The new dominance of Los Angeles on the California industrial map has been associated especially with the rapid expansion of the aircraft industry, which in 1948 employed nearly one-fifth of all Los Angeles industrial workers. Four of the nation's leading aircraft producers (Douglas, Lockheed, North American, and Northrop) have their head offices and main plants in the Los Angeles area; two others (Consolidated Vultee and Ryan) are in San Diego. Although far from the wartime peak, production workers in Southern California aircraft factories averaged about 57,000 during 1947 and 1948. Yet the industry's position is extremely vulnerable, its continued prosperity being dependent almost exclusively on military contracts. The empty spaces of the nearby Mojave Desert, north and east of Los Angeles, have become major testing and experimental laboratories and go far toward explaining Southern California's postwar role as the nation's leading center of aerodynamic research (guided missiles, rockets, supersonic flight, jet propulsion). Largest of such installations is the key Naval Ordnance Testing Station at Inyokern, 160 miles from Los Angeles near Death Valley.

Paralleling the vigorous growth of the aircraft industry has been the city's emergence as an automobile center, second only to Detroit. Although it was the scene of several important early automotive developments, the principal expansion of the industry has occurred only in the past ten years. In 1941 the four Los Angeles assembly plants produced 154,000 cars; in 1948 the capacity was more than 650,000.[5] By the end of the year 15 different makes of passenger cars were scheduled to be in production in the area. Some war-built aircraft plants have been successfully adapted to automobile assembly. The industry's increased emphasis on local subcontracting is stimulating production of automotive parts and accessories. In the fall of 1948, Ford's West Coast purchasing program was operating at the rate of 45 million dollars a year, with nearly 50 independent manufacturers par-

[5] *Western Industry*, San Francisco, July, 1948, p. 58.

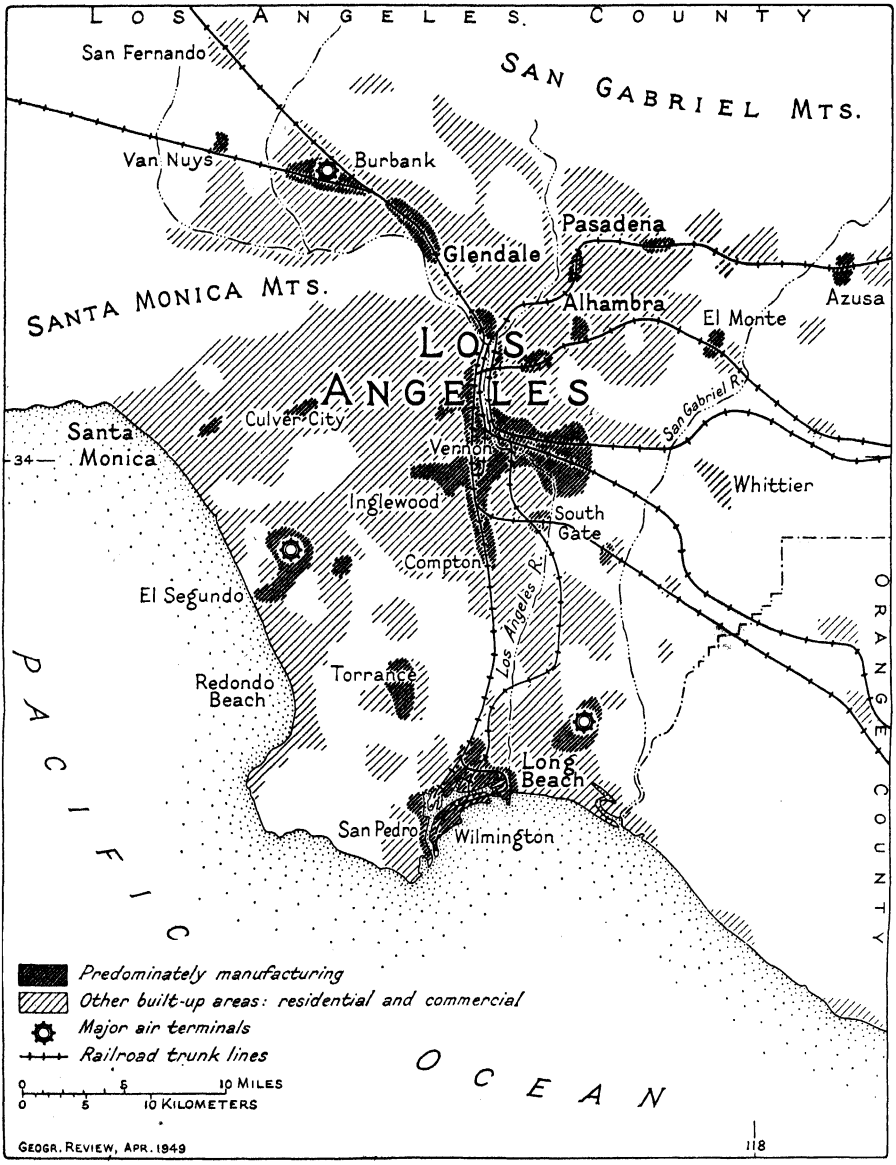

FIG. 2

ticipating. The Ford Company, which assembles more than 14 per cent of its output in California, estimates that transportation of parts to the West Coast adds an additional 10 per cent to their cost, plus a 10-day inventory tie-up en route.[6] Substantial savings in freight charges are promised if California producers can match the costs of Eastern contractors. Two other

[6] *Purchasing*, New York, July, 1948, p. 242.

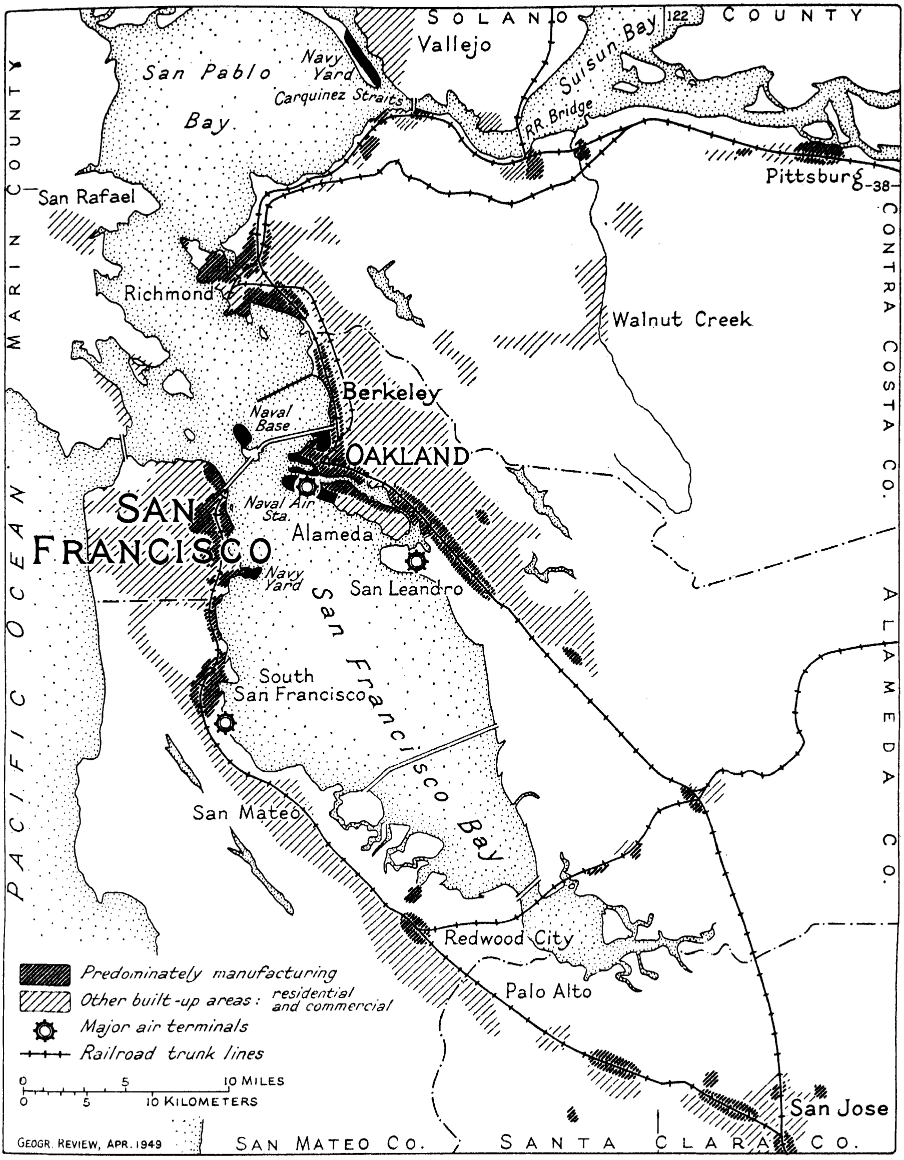

FIG. 3

major automobile producers are preparing to follow Ford's example, but a third has demurred, pointing to the immense cost of dies.[7] Transmissions, frames, engines, and differentials, at least, will probably continue to be shipped in from the East. Despite the expansion of Western iron and steel facilities during and since the war, materials shortages threaten the program

[7] *Western Industry*, September, 1948, p. 98.

fully as much as the inexperience of local producers in mass-production methods and their lack of technical perfection.

As an automobile-tire center Los Angeles has stood second to Akron for at least 20 years, each of the "Big Four" maintaining major units in the city. More recent has been the expansion of the sportswear, furniture, ceramics, and photographic-equipment industries, furthered by the style and prestige value of Hollywood and the "Made in California" label. Each was in a position to take advantage of the inflated consumers' market of the war years, having converted less to military production than the older-established Eastern concerns. In the case of photographic equipment the presence of technical talent associated with the motion-picture industry has been important. Petroleum refining and oil-well-equipment manufacturing are other prominent Southern California industries.

The highly dispersed geographical pattern of Los Angeles manufacturing reflects the recency of its development, influenced by the tendency of plant engineers and management to favor uncrowded, one-story construction on the periphery of built-up areas. The old Vernon industrial district along the Los Angeles River has been greatly extended, and other cells of manufacturing activity have arisen in Torrance, Wilmington, Long Beach, El Segundo, Santa Monica, Culver City, Burbank, Glendale, Pasadena, Alhambra, Azusa, and El Monte. The exceptional space requirements of the aircraft industry have accentuated this scatter. Trucks and pipe lines have played an unusually prominent role in transportation, so that tidewater locations and sites along trunk-line railroads have been in only modest demand.

Representative of this dispersion is the Pacific coast's first integrated blast furnace and steel mill, built during the war at Fontana, some 50 miles east of Los Angeles, amid the orange groves and vineyards of San Bernardino County. It employs nearly 4000 men. Most of the coal comes from Utah deposits more than 500 miles away; the iron ore (hematite and magnetite) is from the Eagle Mountains open-pit mine on the desert 153 miles to the east. Proven ore reserves are reported sufficient to sustain operations for at least 50 years at the present rate of consumption. Despite the high cost of raw-material assembly (the ore was trucked 53 miles to the Southern Pacific main line until completion of a railroad spur to the mine in November, 1948), the economic success of the venture is indicated by the announcement of plans for a second blast furnace. The Fontana and the new Geneva, Utah, facilities together give the West 2.3 per cent of the United States pig-iron capacity as of 1945. In that year the ingot-steel capacity of the seven western

states was 3,500,000 tons, or some 3.8 per cent of the nation's total, more than half of which was represented by the Fontana and Geneva plants.[8]

One of the most striking wartime changes in the population map of Southern California was San Diego County's 91 per cent increase between 1940 and 1946, when a special census listed 552,800 persons. Although employment has fallen off sharply since the war, both in aircraft factories and at naval installations, there has been no compensating decrease in the population.

San Francisco Bay Area

The Bay Area has lagged behind Los Angeles both in population and in industrial development, notwithstanding an earlier leadership that lasted until the middle twenties. Its industry is highly diversified, with primary emphasis on nondurable consumers' goods. The Bay Area leads Los Angeles County in only two major industrial categories, food and shipbuilding. The food industry includes the processing of such tropical raw materials as cacao, copra, coffee, and sugar and the canning of fruits and vegetables. The canneries, which number more than forty, are supplied from the Santa Clara Valley and the delta lands of the Sacramento and San Joaquin Rivers. Employment is highly seasonal, and reliance is heavily on housewives and other auxiliary labor during the summer canning season. Several large glass, paper, and tin-plate container plants service the industry, which is localized in Alameda and Santa Clara Counties.

Employment in commercial shipbuilding and ship repair, long a Bay Area specialty, had dropped off from a wartime high of more than 100,000 to about 7000 in the fall of 1948, but with the Navy's Mare Island-Vallejo Yard (11,500 civilian employees) and the Hunter's Point Drydocks in San Francisco (7500 civilian and 2700 naval personnel) the Bay ranks among the nation's shipbuilding centers. Among other nonindustrial naval establishments that have made San Francisco Bay "the world's greatest naval base" are the Oakland Naval Supply Center (6000 civilian employees), Treasure Island Naval Station (6000 naval personnel), and Alameda Naval Air Station (12,000 civilian and naval personnel).

Except for air-line maintenance facilities and a lone new helicopter plant at Palo Alto, the aircraft industry has entirely by-passed the fog-ridden Bay Area, though during the First World War it was a center of design and

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[8] "Iron and Steel," *U. S. Tariff Commission, War Changes in Industry, Ser., Rept. No. 15*, 1946. See also E. T. Grether and others: The Steel and Steel-Using Industries of California, State Reconstruction and Reemployment Commission, Sacramento, 1946.

production for Liberty engines. Automobile manufacturing, an early Oakland industry, is today restricted to the Ford, Chevrolet, and Dodge assembly plants. In the garment trades likewise, the Bay Area has surrendered an early dominance to Los Angeles. Once specializing in men's work clothing, the San Francisco industry now produces chiefly women's suits and coats; it employs less than one-fifth of the state's 33,000 needle-trades workers.

Routes of the major railroads have determined the industrial site value of most Bay Area land, giving the East Bay a marked advantage over both the Peninsula and Marin County, where level land is at a premium. Deep-water shipping facilities have been an attraction along the San Francisco water front, the Oakland estuary, and the north shore of Contra Costa County, but elsewhere tidal-flat lands have been cheap and offer inexpensive means of industrial-sewage disposal. The oil refineries and chemicals and munitions plants of Contra Costa County, and the huge cane-sugar refinery on Carquinez Strait and the steel mills at Pittsburg, were attracted by these factors together with the easier accessibility of the delta's Rio Vista natural-gas field.

The greatest change wrought by the war was the growth of the East Bay city of Richmond from a population of 23,600 in 1940 to 101,500 in September, 1947. The special census in 1947 showed that the nonwhite population had increased from less than 2 per cent to 14 per cent in this period. Although Richmond shipyards, which employed more than 90,000 workers at their peak of operations, have since closed down, other job opportunities and the availability of low-cost temporary government housing facilities have helped retain the war-induced population gains.

San Francisco City and County, the commercial and financial capital of the region, has suffered from both a cramped peninsular site and inferior rail connections eastward and northward. In the past 50 years its proportion of the state's factory workers has fallen from 57 per cent to less than 10 per cent as new industry has located on the cheaper lands around East Bay and Peninsula cities or in Southern California. South San Francisco is the Peninsula's heavy-industry center, with steel and chemical plants and the Bay Area's largest meat-packing houses. A handful of small, specialized factories in the cities of suburban San Mateo County to the south have made this one of the nation's centers of specialized radio and electronics equipment production and research. Santa Clara County, a cannery and food-machinery center at the south end of the bay that has been another area of rapid postwar industrial growth, has not been included within the Census Bureau's San Francisco Bay Industrial Area.

The Resource Base

The influx of population that California's civic bodies and unofficial boosters have been encouraging ever since the first transcontinental railroad excursion rates began attracting settlers to the West has recently engulfed the state in a multitude of new and perplexing problems. Symbolic of these is the

Table I—Average Number of Production Workers for Selected California Industries and Industrial Areas, 1947*

Industry Group	State Total	Los Angeles Ind. Area[a]	San Francisco Bay Ind. Area[b]	Rest of State
All manufacturing	484,000	49.8%	25.6%	24.6%
Food and tobacco	90,400	26.6	30.0	43.4
Apparel and textiles	37,400	70.0	22.0	8.0
Chemicals	17,500	37.7	37.1	25.2
Petroleum products	15,300	56.2	40.5	3.3
Rubber products	11,100	91.9	5.4	2.7
Furniture and finished lumber products	20,800	64.4	26.9	8.7
Metals and metal products	61,300	51.9	31.8	16.3
Aircraft	56,900	85.1	0.2	14.7
Shipbuilding and repair	17,900	11.8	83.2	5.0
Machinery	48,900	51.3	24.1[c]	24.6
Automobiles and automobile equipment	12,800	64.8	32.8	2.4

*Estimates from records of State of California Department of Industrial Relations, Division of Labor Statistics and Research, San Francisco.

[a]Los Angeles Industrial Area is conterminous with Los Angeles County.

[b]San Francisco Bay Industrial Area comprises Alameda, Contra Costa, Marin, San Francisco, and San Mateo Counties.

[c]Affected by machinists strike during fall months.

low, gray pall of exhaust, incinerator, and factory fumes that lingers for most of the summer over the Los Angeles Lowlands, trapped by the coastal temperature inversion and the mountain barrier to the north. One of the highest per capita motor-vehicle registrations in the country (226 per thousand population in 1947) has made traffic congestion acute in the two metropolitan areas, and it is aggravated by the sprawling pattern of Los Angeles and, in the San Francisco area, by the restriction of transbay traffic to the already inadequate span completed in 1936. Housing and school shortages and the lag in expansion of many utility services have been other, obvious accompaniments of the recent convulsive growth. Problems of water pollution and disposal of industrial waste have become critical in some areas.

The physical limitations of the resource pattern that must permanently

support these swelling urban millions will determine the eventual limits to California's growth. In 1947 the Sierra and redwood-coast forests were being felled faster than ever before, and Monterey and San Pedro sardine fishermen experienced one of their poorest seasons in memory. Recurrent power shortages in years of near-normal rainfall, the heavy drain on the none too large reserves of oil and natural gas, and the high cost and limited availability of fresh water have not, as yet, lessened the booster spirit perceptibly. "The only limits to our growth," reads the promotional literature, "are those set by organizations and men." A governor's commission has forecast a state population of 22 million by the end of the century. The passing of the era of cheap land and water and the growing uncertainties besetting California's specialized agriculture are turning attention more and more to industrial expansion as the means of absorbing the present and anticipated population increase.

Despite intensive exploratory work by the major oil companies, which has kept crude-oil reserves abreast of production during the past decade, the great addition to population and industry and the 1,750,000 kilowatts of steam capacity under construction by the electric-utility companies of the state will force California to go onto a net crude-oil import basis within the next few years.[9] A continued rise in the price of fuel oil seems inevitable, and because of the oil outlook the eventual use of coal is being provided for in most new steam-plant designing. California oil companies are already deeply involved in Utah and Colorado shale-oil recovery programs and in the scramble for Near East oil. The 1200-mile, 30-inch pipe line completed in 1947 at a cost of 70 million dollars to supply Los Angeles with west-Texas natural gas is now to be supplemented by a line from northwestern New Mexico to the Bay Area. Already the steady decrease in output of wet or casing-head gas, a by-product of pumping operations that has been increasingly diverted to the repressuring of oil fields, has curtailed the operations of some industrial users of natural gas.

The southern part of the state, meanwhile, is locked in a struggle with Arizona over Colorado River water rights. The designed maximum capacities of the Metropolitan Water District's Colorado River Aqueduct (1,100,000 acre-feet annually) and the Owens River Aqueduct (400,000 acre-feet annually), even with full practicable development and utilization of local supplies, now appear insufficient for future requirements of Southern California coastal cities. Moreover, the District's prospects of obtaining even

[9] *Civil Engineering*, October, 1948, p. 24.

this amount of Colorado River water are jeopardized both by proposed reclamation projects and by a voluntary Self-Limitation Act passed by the state legislature in 1929 to expedite creation of the Boulder Dam Authority. The amount of Colorado River water required and contemplated to be used in Southern California aggregates nearly 5,500,000 acre-feet annually, but of this amount irrigation districts in southeastern California, primarily in the Coachella, Imperial, and Palo Verde Valleys, have priority rights to a top 3,850,000 acre-feet.[10] Execution of the water treaty with Mexico in 1945 increased the amount of water delivered to that country substantially above previous estimates, and new claims have been made by the State of Arizona. There simply is not enough water in the river to satisfy all the demands. Although the Colorado River Compact of 1922 allocated 7,500,000 acre-feet annually to the three Lower Basin states (California, Arizona, and Nevada), no agreement has ever been reached regarding the disposition of these waters. Several points of controversy have arisen in the interpretation of the compact, and California's right to any waters in excess of the 7,500,000 acre-feet has been challenged on legal grounds.

The large-scale distillation of fresh water from the sea and the construction of an 1100-mile aqueduct to divert surplus Columbia River water to Southern California are under serious study as possible solutions to the water problem.[11] Sewage reclamation and the re-use of industrial water may permit some stretching of existing supplies, though at increased costs. Yet another course of action that might lie open, should sufficient quantities of Colorado River water not be made available, would be for the Metropolitan Water District to buy up the prior water rights of Coachella and Imperial Valley farmlands, as was done at an earlier time in the strife-torn Owens Valley. Southern Sierra streams offer little hope for relief, since their waters are essential to the completion of the Central Valley Project, designed to preserve and extend the rich, irrigated agriculture of the San Joaquin Valley.

Inseparable from the water issue is the question of hydroelectric power, and here again it is Southern California that is especially vulnerable. According to present schedules, load requirements on existing and proposed power projects on the Colorado River south of Lees Ferry, Ariz. (and thus within present economical transmission range of the Los Angeles area),[12] will have

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[10] "California's Stake in the Colorado River," Colorado River Board, Los Angeles, 1947.

[11] R. G. Folsom: "Pacific Ocean: 'California's Last Water Hole,'" *Electrical West*, San Francisco, September, 1948, pp. 104–107.

[12] "The Colorado River: A Comprehensive Report on the Development of the Water Resources of the Colorado River Basin for Irrigation, Power Production, and Other Beneficial Uses . . ." U. S. Dept. of the Interior, Bureau of Reclamation, March, 1946, pp. 205–206.

exhausted the entire potential of the river as far as Southern California is concerned by 1960. This includes the proposed but unauthorized Bridge Canyon and Marble Canyon–Kanab Creek projects, the first of which would make a lake of the lower part of the Grand Canyon and the second curtail the flow of the Colorado River through the National Park to an arbitrary minimum allotment for scenic purposes. Vigorous opposition to thus altering one of the world's great natural attractions is assured. Everywhere in the West the firm flow of hydroelectric power, on which industrial development is dependent, conflicts with agricultural interests, both in dry years and in years of late rains. At such times farmers have contested the release, for power generation, of water stored in reservoirs. The problem was complicated in the winter of 1947-1948 by the increased demand in agricultural areas for electricity for pumping, which made heavy inroads on reservoir storage carry-over and eventually forced a substantial reduction in power output to prevent further depletion of stored water. Lowering water tables have meant increased power demands for lifting water to the surface. The germ of another first-rate water controversy is evident in recent requests for the release of reservoir waters to maintain fish life downstream.

California's recent industrial expansion is a direct response to the opportunities offered by the rich and expanding new Western market. The anticipated large volume of foreign trade with the Pacific Basin has yet to materialize. With such notable exceptions as aircraft, agricultural pumps, food machinery, specialized mining and oil-well equipment, calculating machines, and sportswear, few Western producers have been able to compete for markets east of Salt Lake City. Several of the most successful independent Western firms, such as Magnavox (radio), Farnsworth (television), Caterpillar (tractors), and Le Tourneau (earth-moving equipment), have shifted their major manufacturing operations to the richer Eastern market area. Most of California's new factories and plant expansions during the past 10 years have been branch plants of established national concerns producing lighter, consumers' goods. Independent local capital has played only a secondary role, and most of the older independents have been absorbed by Eastern interests. Savings in sales promotion and distribution and the apparent growing conviction of management that employee and public relations may be better served by expansion away from the older, congested manufacturing centers have been contributing factors. The easing of the West's chronic basic-metals shortages, promised by the war-induced steel developments and the new aluminum mills of the Pacific Northwest, has given fresh hope to Western industrialists, though lower costs are not as-

sured. Since the war a considerable part of the output of the West's new steel mills has gone to markets in other areas.

The Pacific Northwest has paralleled California's pattern of growth on a smaller scale. Bureau of the Census population estimates for July, 1948, indicate an increase since 1940 of 43.3 per cent in Washington (population 2,487,000) and 49.2 per cent in Oregon (population 1,626,000). Here the low-cost federal power from Bonneville and Grand Coulee has provided a major fillip to industry, though the five pig-aluminum plants and one rolling mill that consume 44 per cent of government power output in the region have left the Northwest with a power shortage from which there is no promise of relief for several years.[13]

Economic, sociologic, and military considerations alike are making increasingly convincing the case for further decentralization of our cities and factories and the dispersing of our populations. In concentrating its growth so heavily in California's two great metropolitan districts the West may well be building its house of cards. As the man-made superstructure of California's economy towers higher and higher, its dependence on the cooperation of a capricious Nature increases commensurately. The vulnerability of its water and power supplies alone suggests serious doubts as to the wisdom of continued expansion, at least until the economic application of atomic energy to peaceful ends has been demonstrated. Supported by public tax moneys, most of the state's cities and counties are advertising vigorously for new industries—even badly overcrowded, war-built communities whose temporary government housing now seems destined to permanency. In terms of its resource base California is probably being drastically oversold as a future industrial center. Yet the rising tide of "progress," defined as bigness in everything, is not likely to be stopped by less than war or earthquake, drought or economic collapse. Although the immediate cause of California's recent industrial growth has been the greatly enlarged local market, the lure of a milder Mediterranean climate underlies the continued westward drift of population.

[13] *Electrical West*, October, 1948, p. 73.

THE RAILROAD PATTERN OF THE UNITED STATES*

EDWARD L. ULLMAN

TRANSPORTATION is a true measure of space relations and as such is basic to the study of geography. The relations and connections between areas are reflected in the character of transport and the flow of traffic, and yet the geography of land transportation is almost unknown as compared with that of many other earth features. Extreme difficulty in obtaining adequate data, particularly for American railroads, our most important freight transport medium, probably explains most of this lack. This paper will present some newly available quantitative measures of United States rail facilities and traffic.

Railroads handled about 50 per cent of the total ton-miles of freight in the United States in 1939, coastwise shipping 26 per cent, Great Lakes shipping 10 per cent, pipe lines 7 per cent, highways 6 per cent, and inland waterways 2 per cent.[1] Railroads handled only about 10 per cent of the passenger-miles, however. Coastal and Great Lakes shipping provided the only serious competition to railroads as movers of heavy goods, though pipe lines, because of their economy, especially for natural gas, may well be more formidable rivals in the near future. Railroads, then, are the principal medium through which location factors operate, to influence the distribution of heavy industry and other basic economic activities.

TRACKAGE: MULTIPLE AND SINGLE

Conventional railroad maps either put all railroads in one category or classify them subjectively as main lines, secondary lines, and lines "not shown," a classification that might be acceptable if the lines were put in the proper categories, but they seldom are. There is probably as much difference between the poorest and best railroads as between the poorest automobile road and a superhighway. The heaviest-used 10 per cent of United States railroad mileage carries 50 per cent of the total ton-miles, the lightest-used 10 per cent less than half of 1 per cent; and their construction varies accordingly.[2]

Nevertheless, some general conclusions can be drawn from an over-all

* The author thanks the Milton Fund of Harvard University for financial support in the preparation of this article.

[1] Board of Investigation and Research: The National Traffic Pattern, *79th Congr., 1st Sess., Senate Doc. No. 83,* 1945, p. 22, Table 2.

[2] Data from H. H. Copeland and Sons.

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map of United States railroads (Fig. 1). Density of lines is greatest in the northeastern quarter of the country; the Appalachian, Ozark, and Rocky Mountains show up as barriers; but the most noticeable change in pattern occurs in the level Great Plains at about the 100th meridian, the approximate boundary between humid and semiarid climate and between cropland and grazing land.

The principal long stretches of four-track lines are the Pennsylvania Railroad from Pittsburgh to New York and the New York Central from Cleveland to Albany (Fig. 2). Three-track lines add some mileage, mostly in the same area but extending out slightly farther. The westernmost extension of triple track is Aurora, Ill., the southernmost Washington, D. C., and even these points are not connected continuously with the other three- and four-track lines. Small in extent though the multiple-track sections are, they are almost unique, few other regions have any three- and four-track sections except a few short lines (one of the longer stretches is a 72-mile segment from London to Kettering, England; another, about 40 miles, from Brussels to Antwerp). Their presence in the United States reflects the concentration of enormous streams of traffic produced by the world's most highly developed continental region enjoying free trade. In other words, this is the railroad facility corresponding to American mass production for a large home market. Specifically, the three- and four-track sections are related also to topography, as will be explained later.

The inclusion of two-track lines adds tracks particularly in the Northeast (Fig. 1) but also brings in two transcontinental lines, the Union Pacific and the Santa Fe, and main lines to the south—the Atlantic Coast Line, the Southern and the Illinois Central, and the coal-carrying roads of the Pocahontas region. Note the almost complete absence in Texas, probably explained by a combination of (1) movement through pipe lines of the principal commodity, oil; (2) the level terrain, which permits many alternative routes; and (3) the relatively recent development of the area at a time when competing transportation and improved methods of operating single-track lines were available.

In contrast with three- and four-track lines, the United States has a much smaller percentage of double track than most European countries.[3] In northwestern Europe double track is the rule. In the United States it is still the exception in most areas, for the following reasons:

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[3] In France about half the lines are two track or more in comparison with about one-eighth in the United States (cf. Maurice Pardé: Les chemins de fer des États-Unis," *Annales de Géographie*, Vol. 56, 1947, pp. 274–294, ref. on p. 275; see note in this issue of the *Geogr. Rev.*). In England the proportion of double track is even higher.

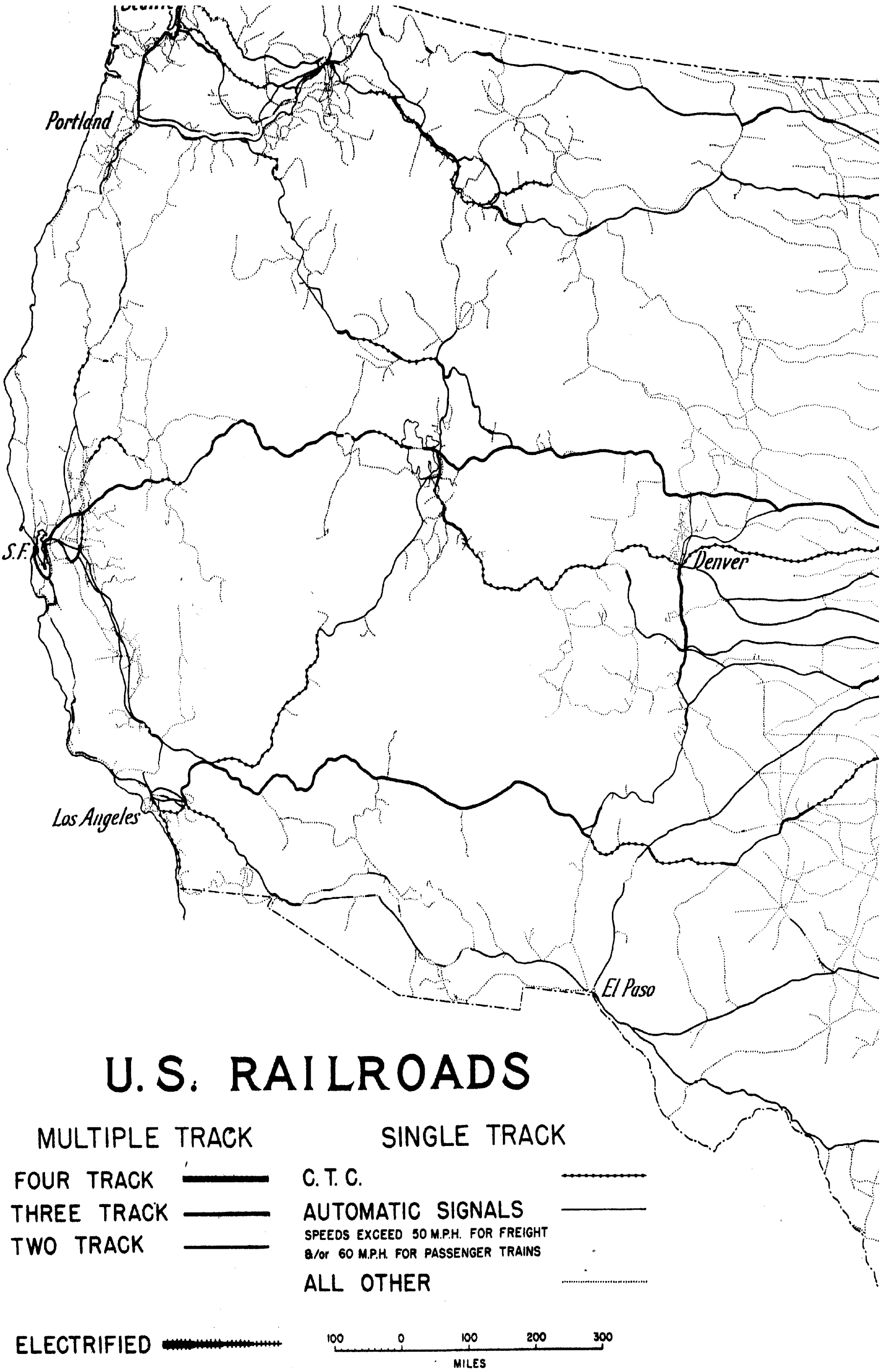
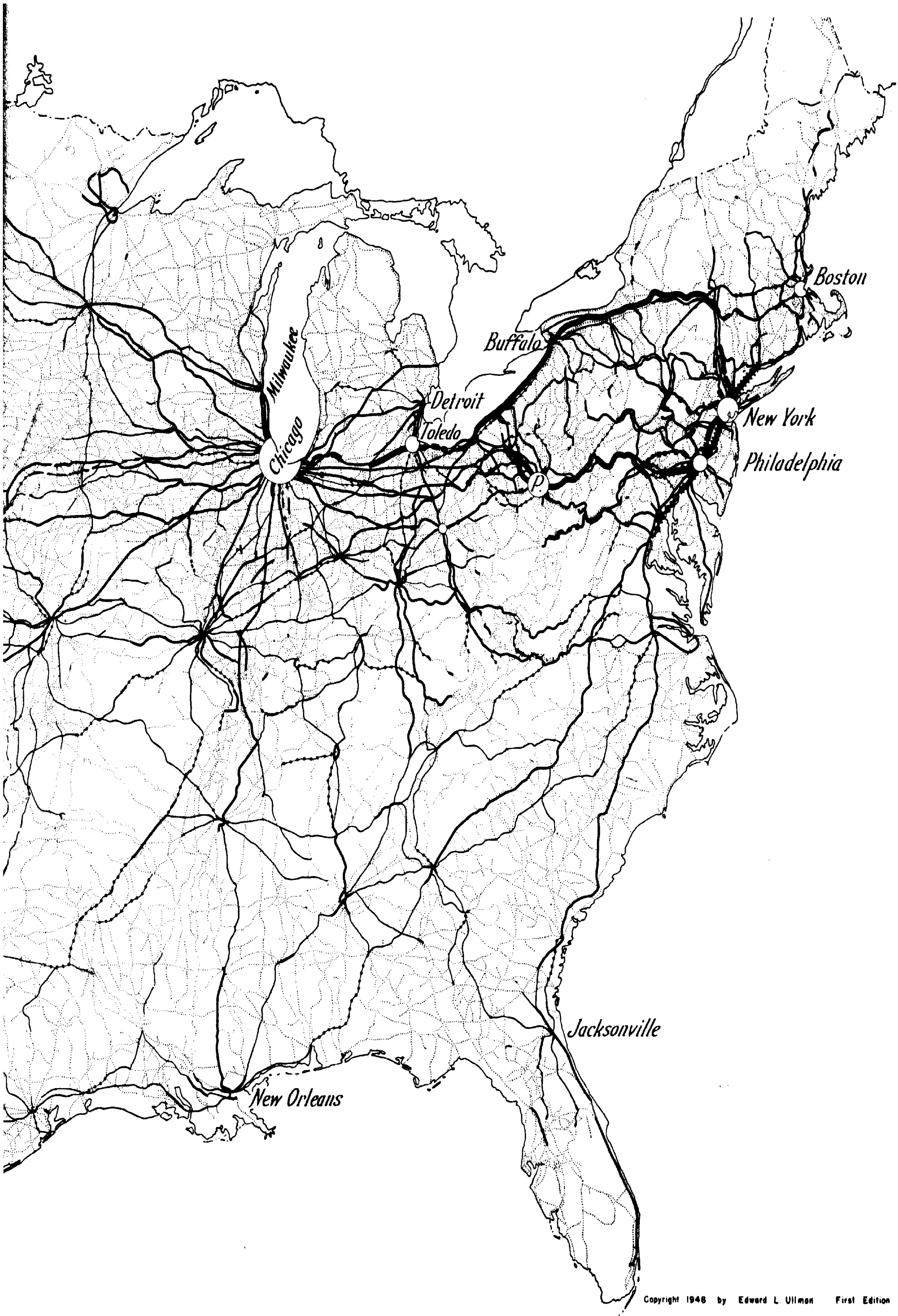


FIG. 1—Railroads of the United States. The lines are classified from most important to least important in the six categories The categories chosen are the best quantitative indicators obtainable from present data.



A two-color map about three times the size of Figure 1 with additional place names and railroad identifying initials is planned ' sale at about $1.00 a copy, with discounts for quantities. Write Edward L. Ullman, Geographic Institute, 2 Divinity Avenue, mbridge 38, Mass."

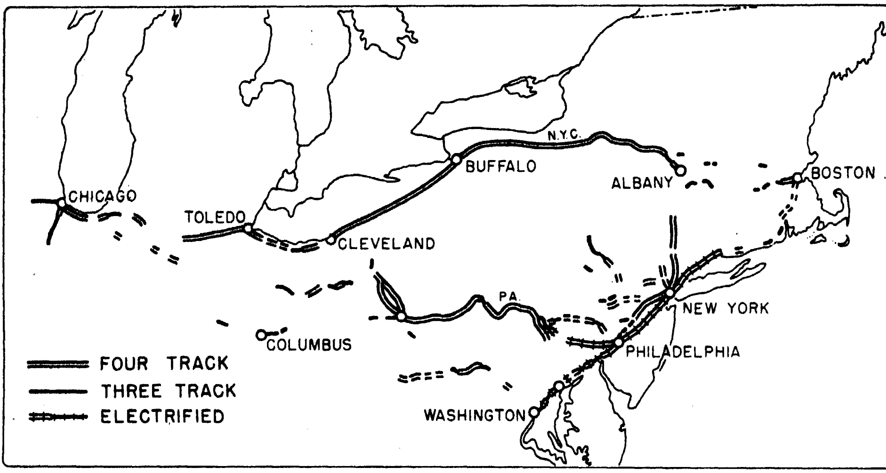


FIG. 2—Location of 3- and 4-track lines in the United States. All lines in this category, save a few short terminal stretches, are in the northeastern quarter of the country.

1. Many sections are less intensively developed than northwestern Europe.

2. The number of trains is smaller on many important railroads because of the relatively lighter passenger traffic and the much greater capacity of freight trains.

3. More alternative routes are available in most sections, mainly because of competition between privately owned roads, in contrast with state or regional monopolies in Europe.

4. Because of the preponderance of single track, operating methods have been adjusted to this condition, and single-track capacity has been increased, spectacularly so in recent years as a result of the improvement of signaling.

Between the single-track railroads of the United States differences are great, though quantitative measures of these differences are difficult to obtain. Type of ballast, roadbed, or weight of rail might be used, but the government does not report such figures, and it would be impracticable to obtain them from the individual roads. One possibility remains—signaling data. On this basis single-track roads can be divided into three categories, from highest to lowest capacity: lines with centralized traffic control (CTC), lines with automatic signals, and lines without automatic signals.

Centralized Traffic Control

Centralized traffic control is a recent development peculiar to the United States, which, in addition to other advantages, increases the capacity of

FIG. 3—Characteristic location of Centralized Traffic Control (CTC) at end of double track. Note the signs indicating end of double track and beginning of CTC. and the bridge and rough country in background where road changes to single track. On the Southern Pacific Railroad's overland route between Ogden and San Francisco at a point between Vista and Massie, Nevada. (Courtesy Union Switch and Signal Co.)

single-track lines so much that it is used as a cheap substitute for the addition of second track.[4] Estimates indicate that CTC increases capacity as much as 50 to 80 per cent. One of its characteristic locations is as a link between sections of double track (Fig. 3).

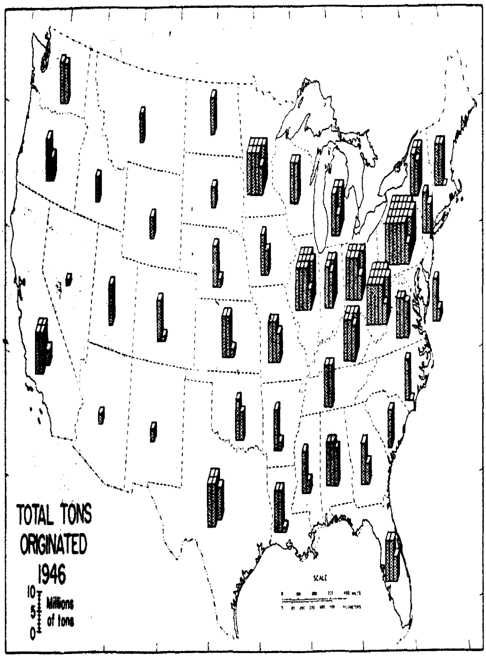
In the United States much CTC is in operation in the West (Fig. 1), because this is the region where traffic has increased most in recent years. Most heavy-traffic lines in the Northeast were already multiple-track, but some double-track lines have had CTC installed in place of a third track, as on the Boston and Maine, the Rock Island, and sections of the Norfolk and Western and the Chesapeake and Ohio.

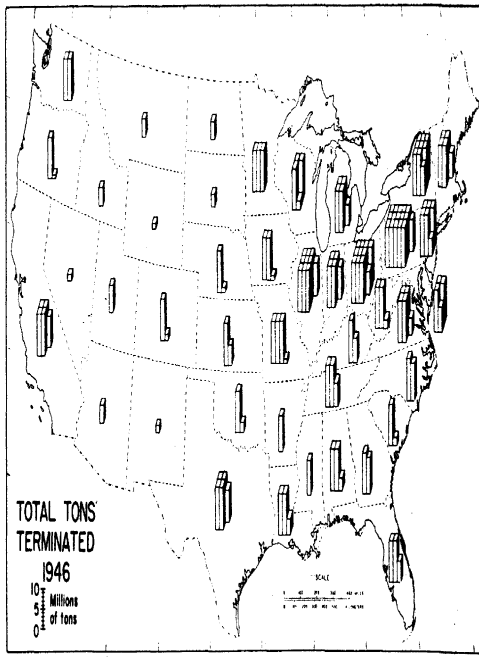
In addition to increasing capacity, CTC makes for faster operation and improves the competitive position of some routes, such as the new, roundabout transcontinental via Denver composed of the Burlington, Rio Grande, and Western Pacific Railroads. It is also peculiarly suited to desert areas, where it is difficult to maintain train-order operators, as on the Union Pacific in southern Nevada.

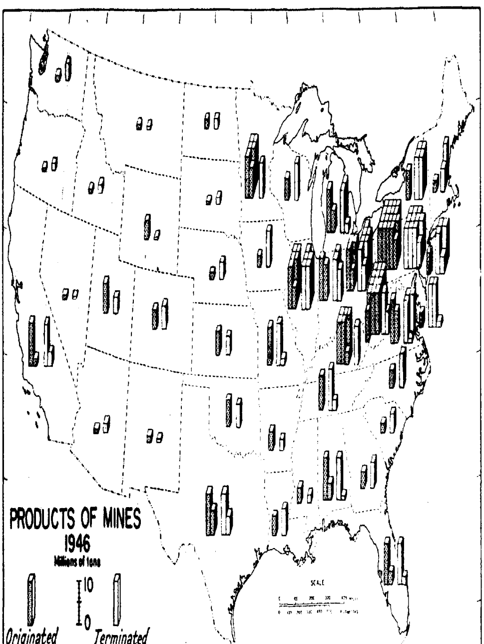
AUTOMATIC BLOCK SIGNALS

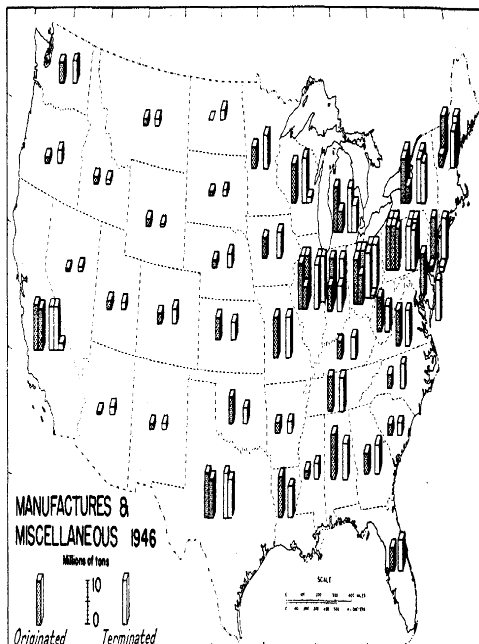
Lines with automatic block signals round out the picture of main lines in the United States, though some main lines on which trains operate at

[4] "Principles and Economics of Signaling," *in* "American Railway Signaling, Principles, and Practice," Association of American Railroads, Signal Section, New York, 1946, (Chap. 3); ref. on p. 58.





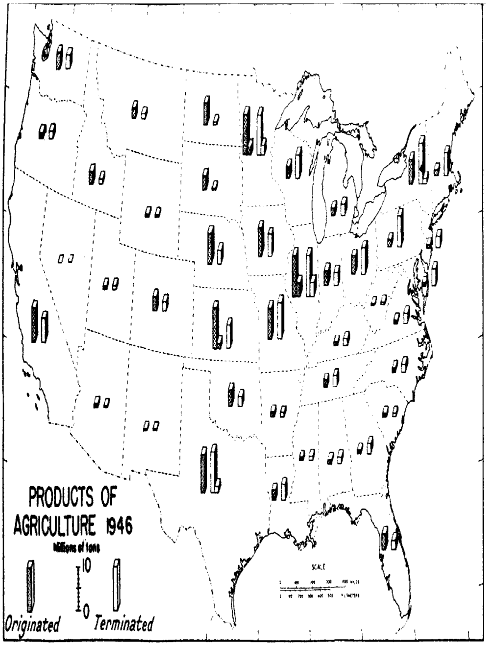


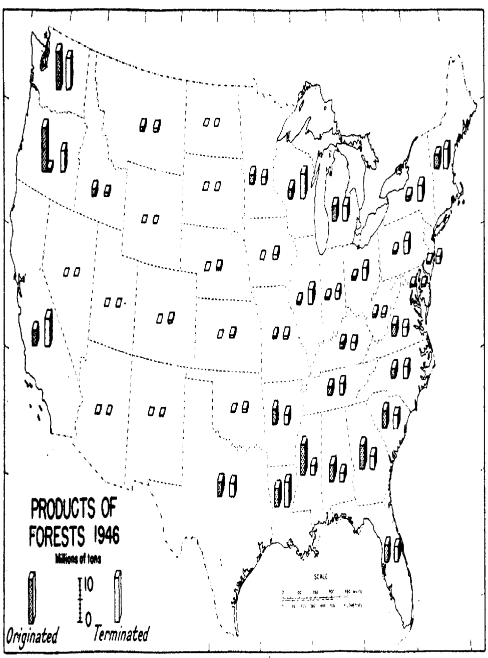


FIGS. 4 and 6

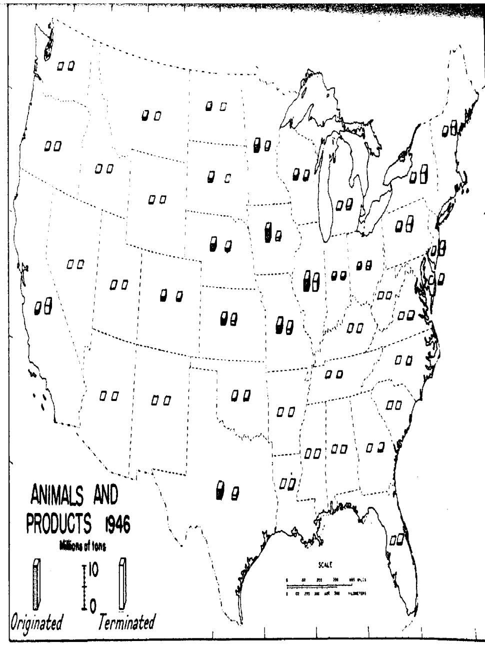
FIGS. 5 and 7

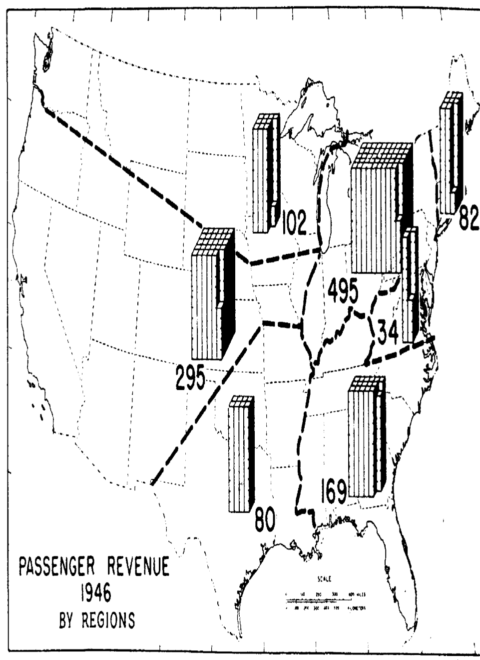
FIGURES 4 TO 10 are freight tonnage maps for United States railroads. Quantities are reported in carloads, which comprise 95





FIGS. 8 and 10





FIGS. 9 and 11

FIGURE 11 shows passenger revenue in millions of dollars based on railway company territories: New England (82), Great Lakes and Central Eastern (combined, 495), Pocahontas (34), Southern (169), Southwestern (80), Central Western (295), and Northwestern

relatively high speeds do not have automatic signals. Automatic block signals are installed to increase capacity, speed, and safety and consequently are good quantitative indicators of the character and importance of track. The trackage map (Fig. 1) shows lines with automatic block signals on which passenger trains operate at more than 60 miles an hour or freight trains at more than 50 miles an hour, because complete data were available for these lines only. Even this information was reported in usable form for the first time in 1948, as a result of an Interstate Commerce Commission safety order.[5] This eliminates some slower track with signals, particularly in mountain areas, though not as much as one might expect. It is therefore a combination measure, though most lines with automatic block signals are so well built that trains can operate at relatively high speeds over them.

Traffic-Producing Areas

Inasmuch as no traffic-flow map for railroads can be compiled from available statistics comparable to maps of highway or waterway flow, traffic data must be provided in other forms—maps of tonnage by states (origin and termination) and passenger revenue by regions and textual descriptions of traffic on the most important lines.[6]

Study of the production maps (Figs. 4–11) reveals a fairly close correspondence with the trackage map (Fig. 1). The industrial Northeast stands out as the pre-eminent traffic-producing area for both freight and passengers, and the arid West and much of the Southeast show up as light-traffic areas. The Pocahontas region of eastern Kentucky, West Virginia, and contiguous Virginia originates enormous quantities of coal (Fig. 6) and thus resembles the neighboring industrial belt in heavy-traffic characteristics, though, as might be expected, it is not a heavy passenger-traffic producer (Fig. 11). The Pocahontas region has a freight revenue of 325

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[5] Map showing automatic-signal locations was compiled from point-to-point tables in ICC 29543, "Appliances, Methods, and Systems Intended to Promote Safety of Railroad Operation," returns to ICC questionnaire forms RR-1, 2, 3, 4, 5, and 6, Interstate Commerce Commission, Washington, D. C., 1947. Unpublished records.

[6] H. H. Copeland and Sons have prepared, at great expense, confidential traffic-flow maps for United States railroads. They will not permit these maps to be reproduced, but they have kindly allowed me to use them for research and teaching.

The source of the tonnage maps is the Interstate Commerce Commission's *Statement No. M-550 (SCS)*, "Tons of Revenue Freight Originated and Tons Terminated in Carloads by Classes of Commodities and by Geographic Areas," calendar year 1946. This has appeared annually since 1940.

The source of the passenger statistics is *Statistics of Railways in the United States, 1946*, Interstate Commerce Commission, Washington, 1948, which covers only the railroad regions. Statistics by states are not available except for a two-week test period in 1933, in the Federal Coordinator of Transportation's "Passenger Traffic Report," 1934, Appendix 2. Freight statistics by stations and trade areas were also published in the "Freight Traffic Report," 1935, Appendix 3, but they give a misleading picture.

million dollars and a passenger revenue of only 34 million, in contrast with New England's 176-million-dollar freight revenue and 83-million-dollar passenger revenue, a ratio of freight to passenger revenue of almost 10 to 1 for the Pocahontas region and about 2 to 1 for New England.[7]

Products of mines made up more than one-half of the freight tonnage originated by United States railroads in 1946, and in years past the proportion was even higher. Coal is by far the most important single commodity. In 1939 it accounted for more than one-third of the total tons carried and provided more than one-fifth of the total freight revenue.[8]

Some features of the mineral traffic in addition to the heavy movement in the coal areas are: (1) the large tonnage originating in Minnesota, representing principally iron ore from the Mesabi range and reflected on the trackage map by the short double-track lines from the Mesabi to the north shore of Lake Superior, where transshipment is made to lake steamers; (2) the large net imports in the nonmining, industrial areas such as New England and New Jersey; and (3) the rather surprisingly large traffic in Florida, two-thirds of which is phosphate rock hauled a few miles from the vicinity of Bartow, America's chief producer of phosphate, principally to Tampa for transshipment by boat.

Maps showing the other major commodity groups tell their own story (Figs. 7–10). The products-of-agriculture map (Fig. 8) is illustrative of the relations between production geography and transportation. The general eastward movement of agricultural products into the populous industrial belt is readily inferred: the important originating areas are the Corn Belt and the Spring Wheat and Winter Wheat Belts of Mid-America; the disproportionately heavy terminating areas are New England and the Middle Atlantic States. Some apparent anomalies may be noted. For example, Iowa, the leading agricultural state, does not originate as much tonnage as its poorer neighbors Minnesota, Nebraska, and Kansas. This is quite logical, however, because Iowa, in contrast with a cash-grain state such as Kansas, feeds its corn to hogs on the farm and thus ships out a lighter-weight but higher-value finished product.

MAIN ROUTES[9]

Two broad zones of movement stand out in the American railroad traffic

[7] *Statistics of Railways in the United States, 1946* (*op. cit.*), Table 158, p. 179.

[8] Board of Investigation and Research: Economics of Coal Traffic Flow, *79th Congr., 1st Sess., Senate Doc. No. 82,* 1945, p. 11, Table 8.

[9] Data for this section have been obtained from a study of Copeland traffic-density charts, railroad passenger timetables, and other sources.

pattern: first, and most important, the west-east movement across the industrial belt; second, the somewhat parallel movement from the Pocahontas and eastern Kentucky coal fields to the northwest and east. Density of traffic on these sets of lines is so heavy that they stand out even more sharply than on the trackage maps. A third major set of lines might be added by including the eastern ends of the transcontinental lines crossing Minnesota, Iowa, and Missouri. Density on these lines, however, is far lighter than on the other two sets.

By far the heaviest traffic in America is on the Pennsylvania from Pittsburgh to New York. The next heaviest, but much less important for freight, is on the New York Central through the Mohawk corridor (Fig. 2). This route divides in the vicinity of Albany, freight density being higher across the Berkshires toward Boston on the Boston and Maine and the Boston and Albany than south along the Hudson to New York City. New York City, however, stands out as the focus of eastern seaboard traffic, because of the heavy freight flows on the Lackawanna, the Erie, the Lehigh Valley, and the Reading-Jersey Central as well as on the Pennsylvania.

The water-level route of the New York Central along the Hudson and Mohawk is a great advantage and enables the road to compete with the Pennsylvania, even though the Central's distance from New York to Chicago is 961 miles, as compared with the Pennsylvania's 908 miles.[10] Although the New York Central is an important route, it is minor in comparison with the combined flows to New York over the other roads from the West and has less than half the freight density of the Pennsylvania alone, which climbs over the mountains.[11] This difference in density is reflected in facilities. Although both lines are four-track, all four tracks of the Pennsylvania are main tracks, whereas on the New York Central only two are built to highest speed standards. Weight of rail on the Pennsylvania is 152 pounds a yard, on the New York Central 127 pounds. Both lines have automatic train-stop or cab signals that make signal changes more quickly visible and thus tend to speed operation and raise capacity. The Pennsylvania, however, has recently installed carrier radio communication on all passenger trains between Harrisburg and Pittsburgh and on all freight trains for a good part

[10] Distances via the freight cutoffs on both lines are slightly shorter (the Trenton cutoff north of Philadelphia on the Pennsylvania, and the Castleton cutoff south of Albany on the New York Central).

[11] In number of passenger trains the New York Central seems to be slightly ahead, with 34 scheduled trains in one direction along the Mohawk, as compared with 28 for the Pennsylvania across the Alleghenies. Additional sections are also run on each line. The heaviest passenger density in the United States, outside suburban areas, is on the Pennsylvania between Philadelphia and New York and on the New Haven between New York and New Haven, followed by the Pennsylvania's line to Washington.

of this stretch, which further speeds operations and raises capacity.[12] Also, from Harrisburg to New York the Pennsylvania is electrified—a third capacity-raising factor. Statements such as "The Pennsylvania route is scarcely second in importance to the New York Central" no longer have a place in geography textbooks.

Southward across the great east-west trunks, such as the Pennsylvania and the Baltimore and Ohio, the percentage of coal handled increases until a peak of 75 per cent or more is reached on such roads as the Chesapeake and Ohio, the Norfolk and Western, and the Virginian. About two-thirds of the coal moves west and one-third east;[13] of the westbound, much is ultimately destined for transshipment from Lake Erie ports, primarily Toledo;[14] the eastbound goes principally to Hampton Roads for transshipment northward by boat up the Atlantic coast, to provide eastern New England with coal.

Space does not permit individual notice of the remaining main lines, but they can be readily picked out from the trackage maps. Mention should be made, however, of the Louisville and Nashville's coal line from the southeastern Kentucky coal fields to Cincinnati, which has traffic comparable with that of all but the heaviest-density lines just mentioned and a heavier freight density than any other line outside the climax area except the short Mesabi iron-ore roads. Other heavy-density stretches are the Illinois Central from the Illinois coal fields northward, the Santa Fe in eastern Kansas, and the Union Pacific between Omaha and Salt Lake City. The Union Pacific has the heaviest freight density (for any considerable distance) of the transcontinental lines, with greatest concentration across Wyoming, primarily bridge traffic funneled across the Continental Divide but also some local coal.

The heaviest Canadian freight density[15] is between Winnipeg and Port Arthur – Fort William, principally wheat from the Prairie Provinces headed for Lake shipment and export. Examination of Canadian traffic-density charts shows that little crosses the United States border. The main Canadian flows are strikingly east-west and remain within Canada.

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[12] "Train Communications on Pennsylvania," *Railway Age*, Vol. 123, 1947, pp. 516–520.

[13] On the Norfolk and Western in recent years 68 per cent was westbound (E. A. Grubb: Coal Supports the Norfolk and Western, *Trains*, Vol. 8, No. 1, 1947, p. 14).

[14] A. G. Ballert: The Coal Trade of the Great Lakes and the Port of Toledo, *Geogr. Rev.*, Vol. 38, 1948, pp. 194–205.

[15] In contrast with the United States, Canadian traffic density has been mapped in published form, in "Report of the Royal Commission to Inquire into Railways and Transportation in Canada, 1931–32," Ottawa, 1932. The effort to keep western Canadian traffic in Canada has been pointed out by S. B. Jones in "The Forty-Ninth Parallel in the Great Plains, *Journ. of Geogr.*, Vol. 31, 1932, pp. 357–368, and "The Cordilleran Section of the Canada–United States Borderland," *Geogr. Journ.*, Vol. 89, 1937, pp. 439–450.

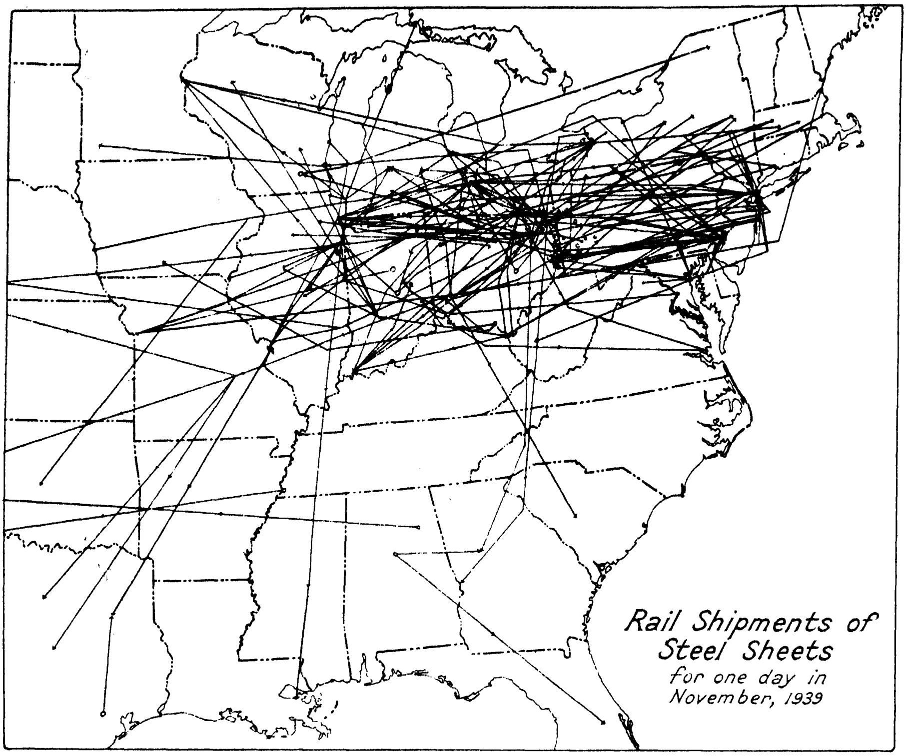


FIG. 12—One-day shipments of steel sheets in November, 1939. This map is representative of crosshauling. Elimination of the basing point system will drastically reduce crosshauling.

SOME TRAFFIC CHARACTERISTICS

Four features characterizing traffic flows on United States railroads should be noted.

1. The routes just described are composed of a series of overlapping long, medium, and short hauls. The average length of freight haul in 1946 was 224 miles, with a range from 170 miles in the eastern district to 303 miles in the western district; the average passenger journey exclusive of commutation was 130 miles (including commutation 82 miles), with a range from the eastern district to the western of 76 miles to 307 miles exclusive of commutation (51 to 205 including commutation).[16]

2. Direction of freight movement is often unbalanced; in general, it is heavy toward the industrial belt and light outbound, with a normal ratio of about 2 to 1 eastbound over westbound on transcontinentals and as much as 3 to 1 or higher in New England.

3. Although the all-important movement of most bulky freight involves

[16] *Statistics of Railways in the United States, 1946* (*op. cit.*), p. 38, Table 44.

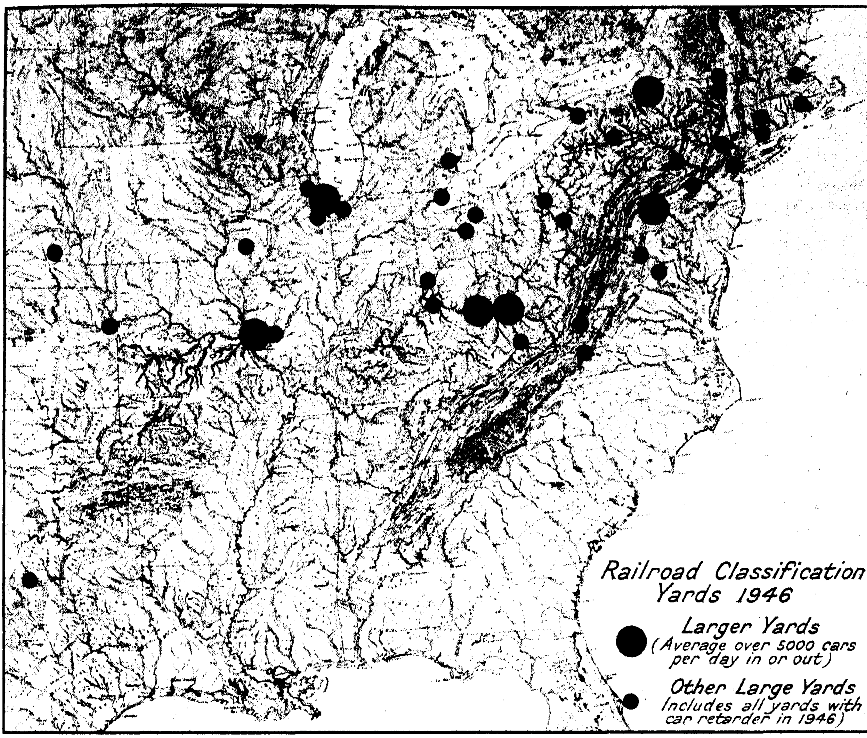


FIG. 13—Location of principal freight classification yards in the United States, 1946. Location of larger yards based on Freight Terminal Survey of Association of American Railroads, 1946; other large yards from same source plus all yards with car retarders (indicative of the larger and busier yards), as reported by Union Switch and Signal Company and General Railway Signal Company. (Base reproduced from Erwin Raisz: Map of Landforms of the United States, 1939.)

relatively little crosshauling, higher-value freight may show considerable crosshauling (Fig. 12). The recent Supreme Court decision abolishing the basing-point system for cement and the voluntary action of the steel industry in abolishing basing points for steel may eliminate much crosshauling in these commodities, but brand names, national advertising, and other factors apparently will maintain crosshauling in higher-priced goods.

4. Goods do not always move by the shortest or even easiest route between terminals. The Federal Coordinator of Transportation estimated that in 1934 the average freight car moved above 11 per cent farther than if it had used a direct line in common use.[17] Studies of special commodities by the Board of Investigation and Research in 1939 indicated an average circuity of almost 20 per cent.[18] Competition between railroads is the primary

[17] Freight Traffic Report (*op. cit.*), Vol. 1, p. 77.
[18] The National Traffic Pattern (*op. cit.*), p. 47.

explanation, but valid reasons exist for some circuity, such as avoidance of congested terminals. In a few cases a longer route even has cheaper rates (justified on the grounds of necessarily slower service) such as the so-called differential routes via Canadian lines from New England to the Middle West. Passenger traffic has less circuity because loss of time means more. Geographers, however, will find it to their advantage to know that there are alternative routes they can take, especially for longer trips, such as from Chicago to New York via Hamilton, Ont., Buffalo, Pittsburgh, Cincinnati, or Washington, D. C., all for the same fare. Don't, however, trust a local agent to sell you a circuitous ticket on short notice!

Relation of Railroads to Topography and Production

Railroads are extraordinarily sensitive to grades. Many routes try to avoid grades greater than 0.5 of 1 per cent. Most transcontinental main lines have a maximum grade of 2.2. per cent across mountains. Valley alignments on a national scale are discernible in many places, as along the Mohawk Valley or along the Great Valley. One effect of grades is to cause railroads to add extra tracks, even though cost of construction is high, in order to enable the return of pusher locomotives or to run passenger trains round slow freights, as on the Boston and Albany, the Boston and Maine, and the Lackawanna, or to install better signaling in mountains—for example, CTC on the Union Pacific across the Blue Mountains of Oregon. Most important, however, are the reduction in number of through routes and the channelizing of traffic, which necessitates extra tracks in the constrictions, as on the Baltimore and Ohio across the eastern Appalachians.

The funneling of traffic through mountains places most large classification yards at points where rail lines fan out on leaving the barrier zone (Fig. 13); such points are generally not close to large cities. In addition, of course, most of the large yards are in the heavy-density area, the northeastern quarter of the country.

Sensitive though railroads are to grades, the predominant locating factor seems to be traffic. The heaviest-traveled route in the United States, the Pennsylvania, climbs the mountains to connect the east and west sides of the all-important manufacturing belt. Railroad facilities generally are most numerous in high-production areas; the coal in the Appalachians, for example, acts as a powerful magnet drawing railroads to these mountains. Although relief strongly affects the local or site alignments of major American railroads, production and traffic appear as more important determinants of their regional arrangement and location.

THE SOCIAL GEOGRAPHY OF DUBLIN

JOSEPH P. HAUGHTON

THE emergence of Dublin as an important settlement dates from the end of the ninth century of our era, when the Danes, spreading through the Irish Sea Basin, first began to use the site as a base for their operations. Various natural and artificial factors have ensured its development through the centuries, and the present town, with its half a million inhabitants, not only bears traces of its long history but also has the appearance and function of a modern capital city.

SITE AND SITUATION

Dublin stands at the mouth of the River Liffey, which cuts through drift-covered limestone lowlands to flow into a wide bay. This bay forms a natural entry into Ireland from the east and has no effective rival between the Leinster Chain and the Carlingford Mountains; for the estuaries of the Boyne and other rivers flowing eastward into the Irish Sea are shallow, and the coast consists of low cliffs or sandy beaches. Dublin, the terminus of routes from Wicklow and Wexford and from the whole of the central lowland, was therefore more suited to become a great port than any of its rivals in this part of Ireland; and roads, canals, and railroads now accentuate its natural advantages. Contact with British ports has varied, but Dublin's chief trade today is with Liverpool and Holyhead, from which communication with the English Lowland is easy through the Cheshire Gap.

The River Liffey, which runs through the heart of Dublin as the Thames through London and the Seine through Paris, enters the city from the west in a valley cut into thick boulder clay to a depth of 50 feet or more; it is floored with alluvium and bordered by gravel terraces.[1] As it nears the sea, the valley widens and receives the waters of several small rivers; some of these now run underground through the city, but at least two remain at the surface, the Dodder on the south and the Tolka on the north.

HISTORICAL DEVELOPMENT

A thousand years ago the Liffey, flowing into Dublin Bay across mud flats subject to frequent flooding could be forded at several points, though probably with some difficulty. Evidence of early settlement suggests the

[1] A Farrington: The Pre-Glacial Topography of the Liffey Basin, *Proc. Royal Irish Acad.*, Vol. 38, Sect. B, No. 9, 1929, pp. 148–170.

➤ MR. HAUGHTON is lecturer in geography at Trinity College, Dublin.

occupation of the spur of dry ground on which the Castle now stands (Fig. 1). This was near the important crossing place reachable by seagoing ships that gave the city its Irish name, Baile Atha Cliath (the town at the ford bridged by hurdles). Permanent settlement is recorded as having taken place here in A.D. 840, but possibly there was a village already in existence before that time. It is probable, too, that the estuary of the River Dodder also attracted the attention of the early seafarers; for the gravel ridge at Ringsend, where it enters the Liffey, shelters it from the open sea, and thus it would have provided a safe anchorage for their ships and saved them the navigation of the difficult channel leading to the town itself.

In the twelfth century the Danes or Ostmen,[2] as they were sometimes called, whose power had varied considerably, were finally displaced by the Anglo-Normans, and the town was given the status of a capital. The Ostmen were not driven out completely, however; a number of them remained on the north bank of the river in the vicinity of St. Michan's Church (Oxmantown).[3] The increasing importance of Dublin as an administrative center led to the building of a wall from the ridge to the river, the construction of a fortress, long to remain the symbol of English power in Ireland, and the restoration of Christchurch Cathedral, a Danish foundation, now one of Dublin's oldest buildings. A century later St. Patrick's Cathedral, its rival and neighbor, was founded on a low-lying site south of the city walls; but most building sought the security of the walls, and it was not until the sixteenth century that much development took place eastward and on the north bank of the river. Trinity College, founded in 1591 near the Liffey on the site of a dissolved monastery, formed the eastern edge of the town for the next hundred years. The seventeenth and eighteenth centuries saw the reclamation of large areas along the river, which was confined between the two parallel lines of quays that remain one of the most striking features of the city to this day.

The development of Dublin from medieval time has been marked by three periods of expansion, which coincided with times of stable political conditions: (1) the latter half of the seventeenth century, when the effort to keep within the walls was finally abandoned; (2) the latter half of the eighteenth century, when Dublin was the second city in the British Empire; and (3) the post-1922 years, when Dublin became the capital of a self-governing country expanding in industry. The first of these expansions was a general movement outside the walls; the space between the Castle and

[2] A better name for them would be "Scandinavians."

[3] Edmund Curtis: Norse Dublin, *Dublin Hist. Record,* Vol. 4, 1932, pp. 96–108.

Trinity College was gradually filled up, and the medieval walled city, which as late as 1649 had endured a siege, began to decay. Many of the improvement schemes at this time were inspired by the viceroy and his followers, who, having been in exile on the Continent during the Cromwellian phase, had returned with elaborate ideas on town planning. The remarkable enter-

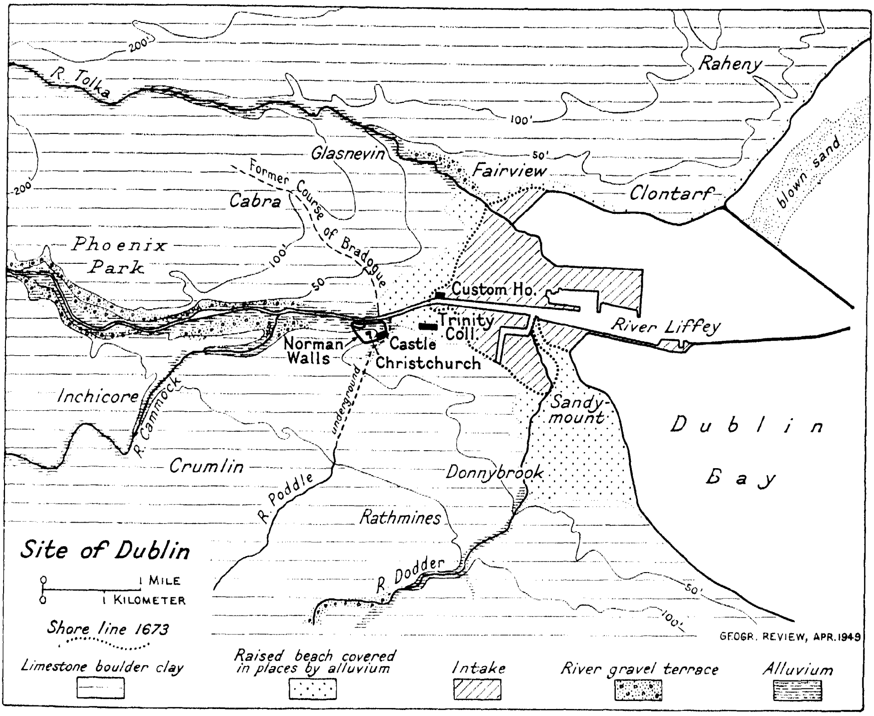


FIG. 1—Site of Dublin with location of original city walls.

prise of the rulers and citizens of the day can be seen in two of Dublin's most famous recreation grounds, the Phoenix Park and St. Stephen's Green. The park, largely the gift of the viceroy, now covers about three square miles immediately to the west of the city. The green, an ancient common, was enclosed under the auspices of the municipal authorities, who let the surrounding land for building in order to stimulate development southeastward. It was subsequently (1880) improved and laid out as a public park.

The second period of rapid expansion was due to a combination of economic and political factors.[4] Dublin was gradually becoming an important administrative center with a numerous aristocracy. Under their encouragement native industry began to grow, especially after 1779, when legislation

[4] C. E. Maxwell: Dublin under the Georges, 1714–1830, London, 1936.

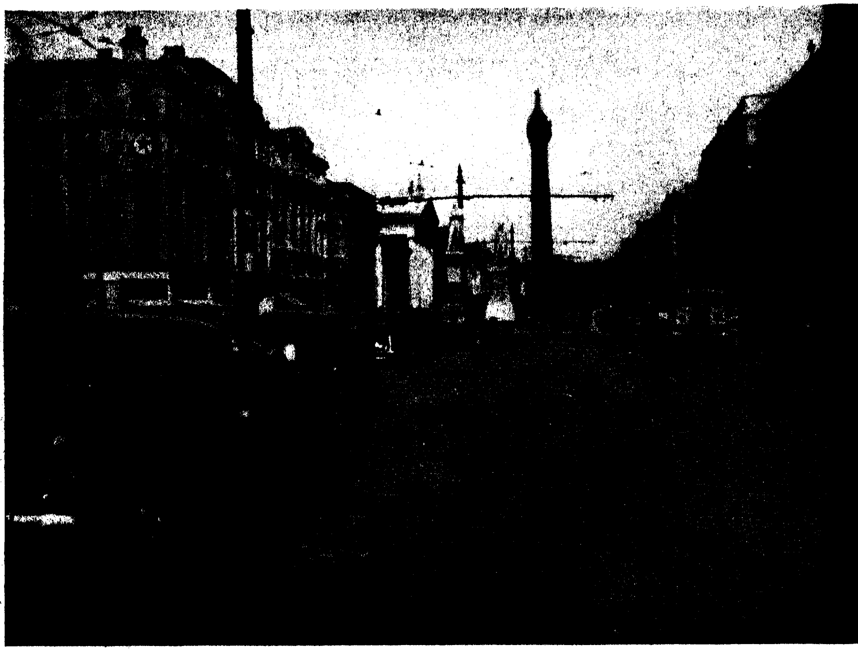


FIG. 2—O'Connell Street, part of the great north-south route planned by the Dublin Wide Streets Commissioners. Nelson Pillar in the background.

FIG. 3—Moore Street with its improvised barrows and stalls.

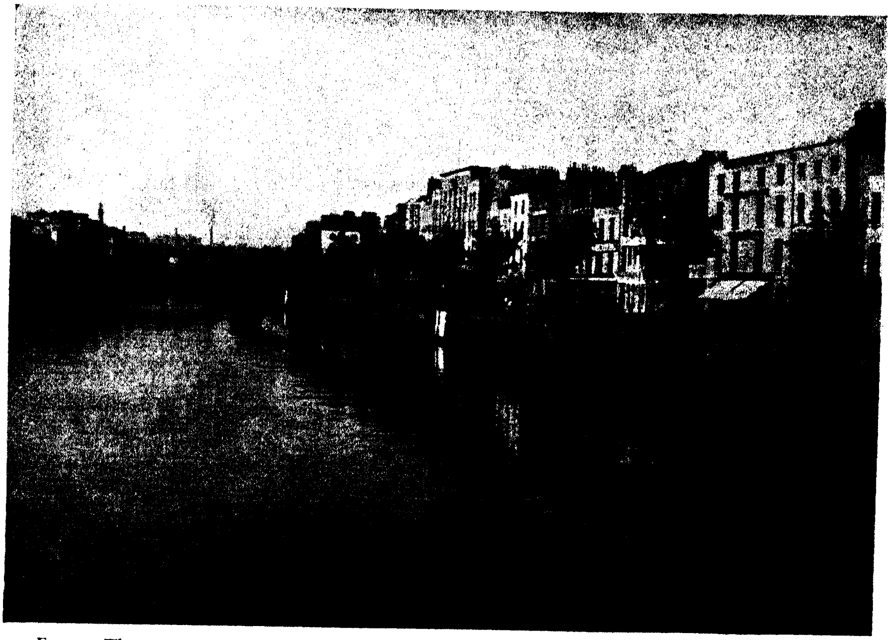


FIG. 4—The quays on the north side of the Liffey looking inland from O'Connell Bridge. The factory chimneys in the distance belong to a large brewery.

FIG. 5—The river Dodder entering the Liffey at Ringsend.

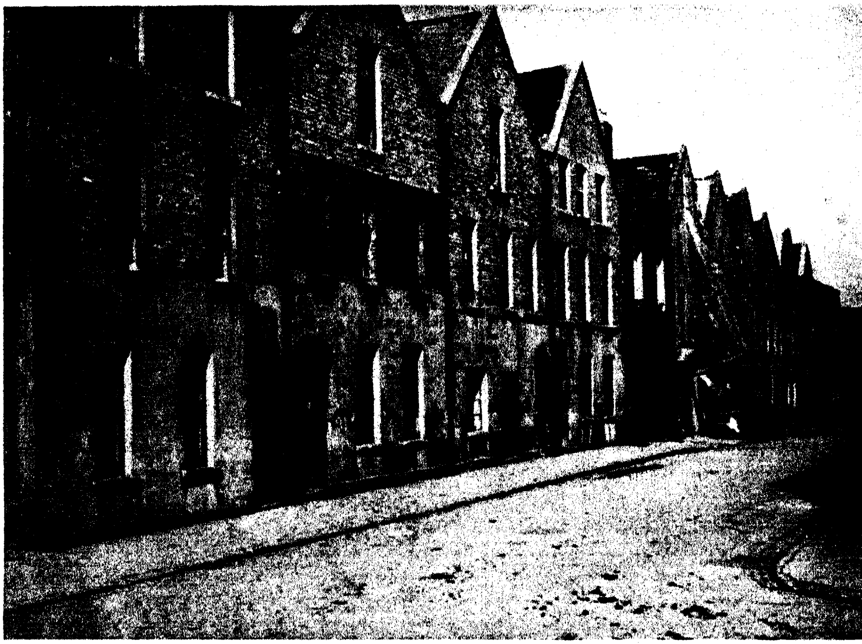


FIG. 6—Seventeenth-century weavers' houses, now much decayed.

FIG. 7—Well-kept Georgian houses in Merrion Square, west. The one with the flagpole is a legation.

in the English Parliament allowed free trade between Ireland and other countries. During this phase a happy influence was at work, the Dublin Wide Streets Commissioners, a planning body with considerable powers appointed by Act of Parliament in 1757 to clear open spaces for buildings and to widen streets. The commissioners had substantial grants from the Irish Parliament and were empowered to raise money by duties on coal, cards, and clubhouses. The great Sackville (now O'Connell) Street became the chief north-south route through Dublin when it was continued across the river in 1796 and tended to move the center of gravity of the town eastward. These planners were far ahead of their time, and the Circular Road around Dublin completed toward the end of the century was an experiment as bold as any planned in the twentieth century. The commissioners ceased to function in 1841, but not before they had made an indelible mark on the structure of the city; its layout then was substantially the same as it is today. The magnificent houses that lined the new streets and squares were erected regardless of expense and survive as mementos of a time when the city was the center of the brilliant intellectual, social, and political life of the Anglo-Irish ascendancy. Most of the fine public buildings gracing the center of the modern town are also legacies from this period: the Parliament House (now the Bank of Ireland), the Royal Exchange (now the City Hall), the Rotunda Hospital, the Custom House, the Four Courts, and many others testify to the lavish expenditure of money in development of the city.


FIG 8—A Georgian tenement house in York Street.

The increasing maritime trade, long a basic feature of Dublin's commercial life, stimulated the improvement of the port and led to an expansion of communications with the hinterland by the building of two canals westward across the central lowland to link Dublin with the River Shannon. In

early times the Liffey entered the bay through a series of shallow channels, which formed a hazardous passage for ships coming into the harbor. Port development required the deepening and fixing of these channels. The first practical step was taken by the Ballast Office in the seventeenth century, when walls were constructed on both sides of the river across the marshy flats. Toward the end of the eighteenth century the Great South Wall, a long breakwater, was built out into the bay from the south shore, and shortly afterward a similar wall or embankment was built out from the north shore, so that the tidal and river waters were confined to a single channel in order to wash away a troublesome sand bar. This scheme met with some success, but constant dredging is still necessary to maintain the deep-water channel, which now extends for more than four miles in from the mouth of the harbor.

With the union of England and Ireland in 1800, Dublin lost much of its political significance, and many of the people who had been closely associated with Parliament moved away. Dublin was at this time a compact city, lying within an area bounded by the Royal Canal on the north, the Grand Canal on the south, and the Phoenix Park on the west. In the following years the planning of the preceding century was not continued everywhere, and the suburbs acquired a variety of housing. Poor dwellings were built on vacant spaces within the city behind the large buildings, and the decay of many of the fine eighteenth-century Georgian houses began.

Communications were greatly improved. The development of the steamship in the beginning of the century and the opening of the railroad from Holyhead to London in 1850 brought London within a day's journey, and Dublin gradually became the focal point of a network of railroads that linked it with all parts of the country. Nevertheless, it failed to become a great industrial city, mainly owing to lack of coal and iron and to frequent labor trouble. At a time when Belfast was being transformed into a large manufacturing town, Dublin was growing slowly though not ungracefully.

The restoration of Dublin as a seat of independent government in 1922, ushered in, after temporary dislocation, a third period of rapid expansion. Self-government brought renewed prosperity and vigor. New industries were established under the protection of tariffs, and a rapidly increasing population led to an expansion on all sides and necessitated a revision of the city boundaries.

Distribution of Population

The present city is the undisputed center of Eire. Its population of

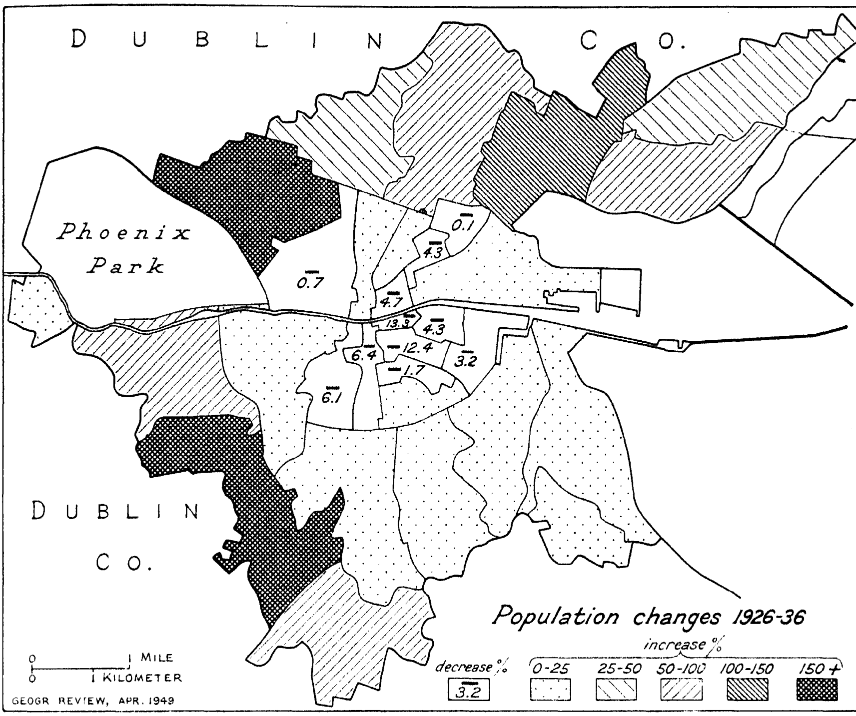


FIG. 9—Changes in population 1926–1936. The figures are plotted by wards.

550,000[5] represents nearly one-fifth of the total for the 26 counties, and it is likely that the proportion will be even greater in the future; for although the country as a whole has been steadily losing population, Dublin has continued to grow.

	EIRE	DUBLIN	PER CENT
1851	5,111,557	308,040	6
1901	3,221,823	358,443	11
1926	2,971,992	404,094	14
1936	2,968,420	472,958	16
1946	2,953,452	506,635	17

The average density of population for the whole of Dublin is about 25 to the acre, but in certain parts of the city the density reaches 150, and in the Mountjoy Ward 185. In 1931 the most densely populated borough of London, Southwark, had a total population of 171,700 living on 1132 acres, a density of 152. The thickly populated areas are (1) a central belt, the oldest and poorest part of the city, extending westward from St. Stephen's Green, then northward to the Liffey, taking in the area around High Street, to the

[5] Preliminary report of the 1946 census. This figure includes the borough of Dún Laoghaire.

west of the Castle; (2) an extensive area of Georgian streets and squares in the northeast centered on Mountjoy Square and extending northward as far as the Royal Canal; (3) the dock area lying directly to the east of Trinity College; and (4) the new housing estates of Marino, Cabra, and Crumlin, which have come into existence only within the last 25 years.

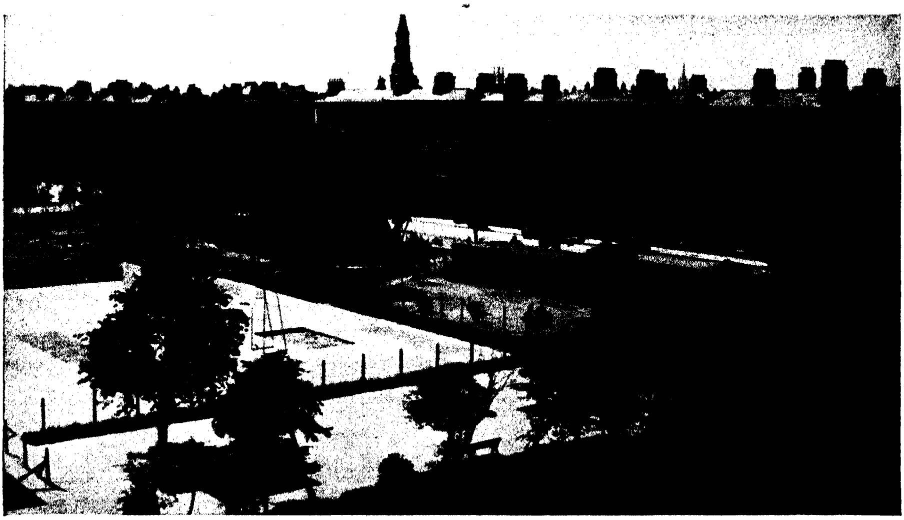


FIG. 10—Mountjoy Square, one of the most thickly populated areas in Dublin. Many of its houses, however, are still in a reasonably good state of repair.

The parts of the city showing a low density of population are (1) the main shopping area, which extends northward across the river from St. Stephen's Green, and in which the high value of property confines its use to business and commercial undertakings; (2) a belt eastward from this along both sides of the Liffey, where most of the space is taken up by dock installations, factories, and warehouses; (3) an area southeast of Cabra where there are a number of public institutions, including a large mental hospital; (4) an area south of the Phoenix Park where there are a small war memorial park and extensive railroad sidings; and (5) an area east of Crumlin that is at present undergoing rapid development.

Most of the densely peopled part south of the Liffey shows a slight decrease in population (Fig. 9); north of the river, however, an increase is still evident, as many of the old houses are replaced by flats or so transformed that they can accommodate more people. Increases are also recorded in all the suburbs as vacant spaces are filled and the larger houses turned into flats. The built-up area has been greatly enlarged by the addition of cottage housing estates at Cabra and Crumlin; taken as a whole, both of these have had a phenomenal increase in population, but it is interesting to note that some of

the older streets in these new areas are already beginning to show a decrease, probably accounted for by the migration of the younger members of the households to work in England.

Occupations

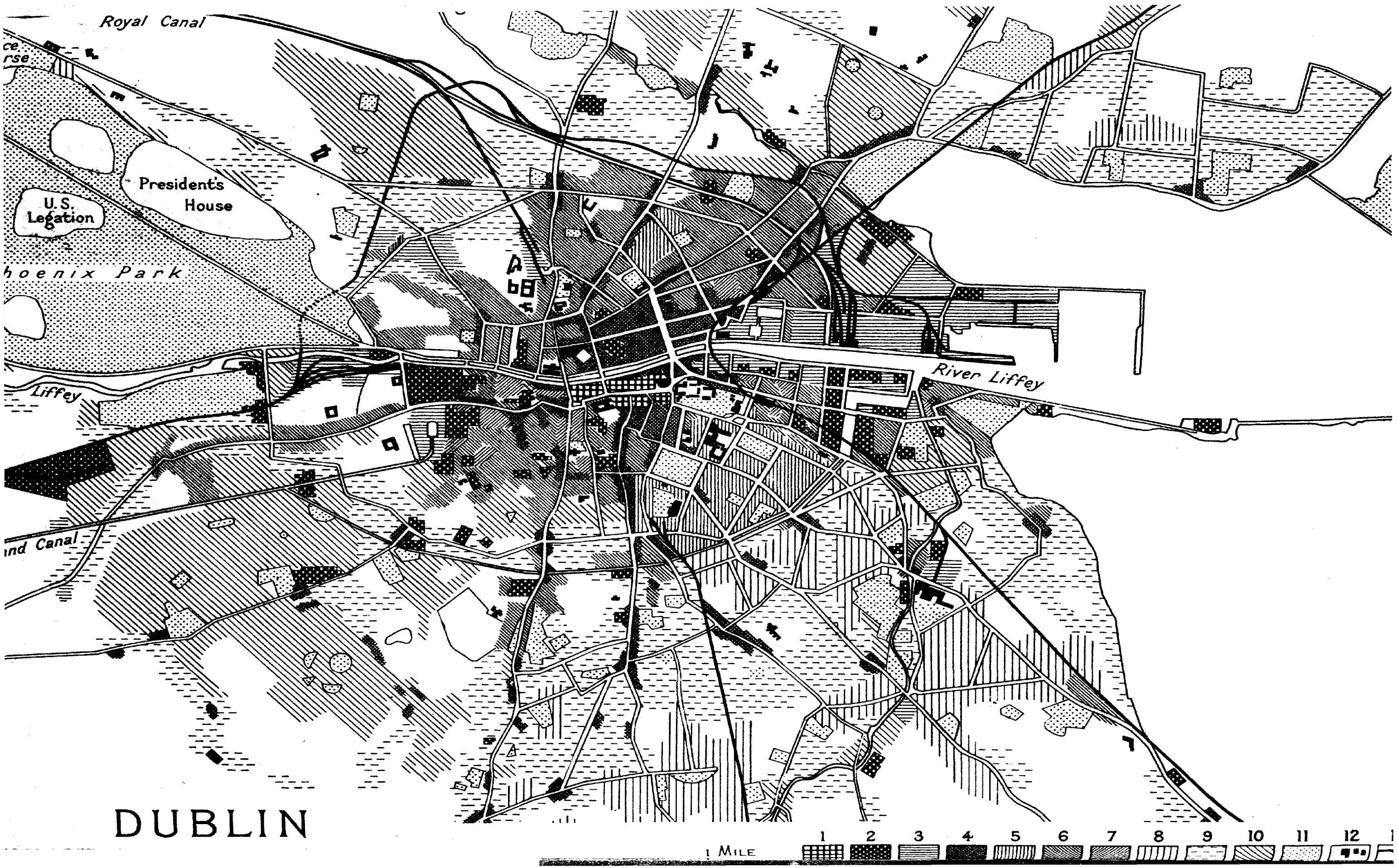
Dublin is now not only the administrative capital of Eire but also its one important collecting and distributing center. At the 1936 census 18 per cent of the working population were engaged in administration and in the professions, 30 per cent in commerce and transport, 34 per cent in industry, and the remainder in personal service. The 46,000 persons engaged in commerce and finance constituted 40 per cent of the total for the whole of the country. Nearly all banks and insurance companies and many of the industrial undertakings throughout Eire have their head offices in Dublin. Industry, now giving employment to more than 68,000 people, is becoming increasingly important, but with a few notable exceptions the factories are small, and the wide variety of goods produced are mainly for the home market. The commercial life centers around the activities of the port, which takes four-fifths of Eire's overseas trade. The imports, largely raw materials for use in the city or in other parts of the country, include coal, oil, timber, and grain, and also a considerable quantity of finished articles, especially machinery, from England and the Continent. Exports are associated with the brewing industry and the livestock from the rich grazing lands of Meath and Dublin Counties. In 1938 livestock exported were: 377,000 cattle, 209,000 sheep, 10,000 pigs, 3200 horses.[6]

Weaving seems to have been one of the earliest manufacturing activities. The weavers' guild was granted its charter in 1446, but the industry owes most of its success to the skill of the Huguenot workers who came from France in the seventeenth century. The material woven was chiefly wool, and the trade varied considerably according to economic conditions both in England and on the Continent. Silk, linen, and cotton were also woven, but lack of capital, severe foreign competition, and industrial unrest retarded their development. The cotton weavers eventually gave way to the English power looms, and the linen manufacturers were unable to compete with their rivals in the north of Ireland. Today the weaving tradition is carried on by the small but important poplin[7] industry, and although the material is no longer manufactured in the homes of the workers, it is still regarded as a characteristic Dublin product.

Other industries with an international reputation are brewing and

[6] *Irish Trade Journ. and Statistical Bull.*, Vol. 14, No. 2, 1939.

[7] A mixture of silk and wool so woven that only the silk is visible on the surface.


Royal Canal
President's House
U.S. Legation
hoenix Park
Liffey
River Liffey
nd Canal
DUBLIN
1 Mile
1
2
3
4
5
6
7
8
9
10
11
12

to one mile.

Key: 1, commercial core; 2, factories; 3, transport and warehouses; 4, shopping centers; 5, substantial city residences; 6, old tenements and slum areas; 7, new tenements; 8, expensive suburban houses; 9, medium-sized suburban houses; 10, cottages and corporation housing estates; 11, recreation; 12, public buildings; 13, railways.

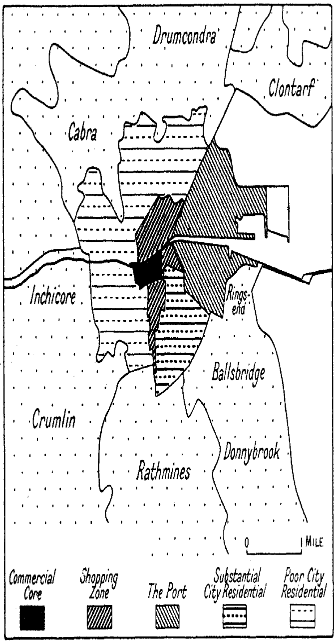
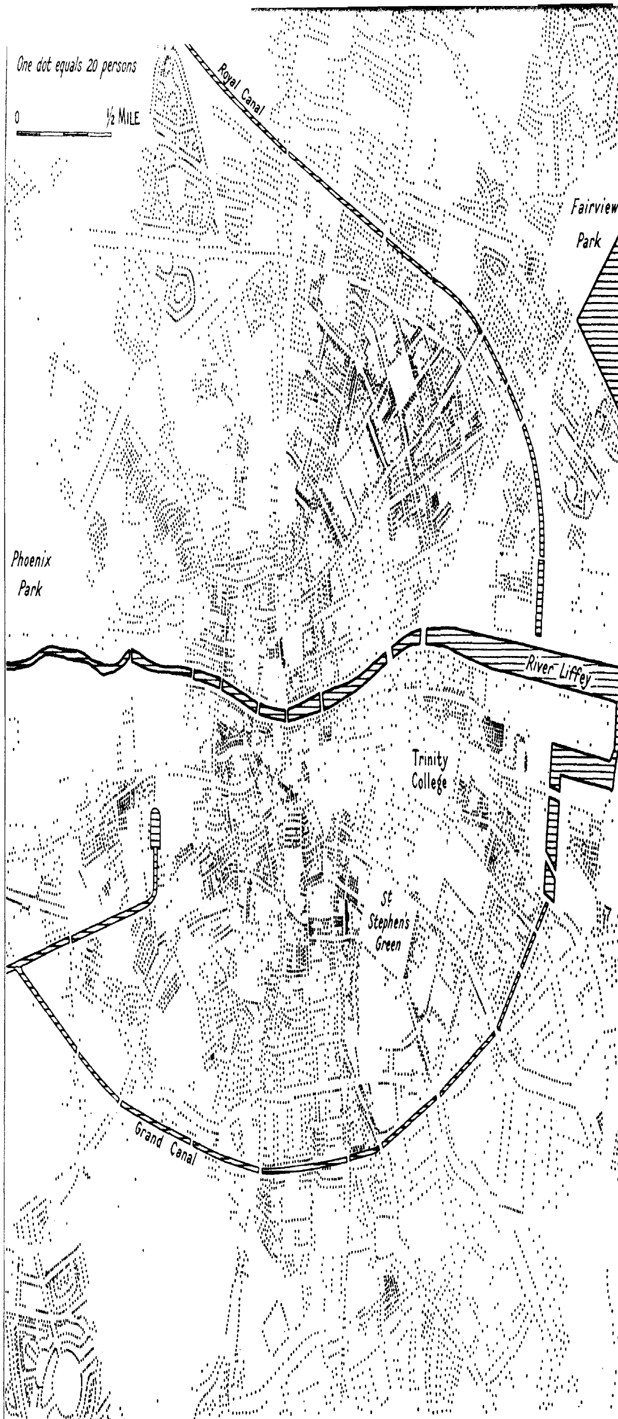


FIG. 12—The functional regions of Dublin.

FIG. 13 (right)—Population density map of Dublin. The smallest unit for which population statistics are available is the ward (Fig. 9), which is too large to give satisfactory results. To construct this map data for individual streets and parts of streets were obtained from a survey made for issuance of ration cards in 1945, and the figures were kindly made available by the statistics branch of the Department of Industry and Commerce, Dublin, and were plotted on a six-inch map so that it was possible to place the dots over the houses themselves.



biscuitmaking. In the seventeenth century Ireland was already famous for its ales, which are said to owe much to the suitability of the water; whiskey, however, was the chief drink of the populace until the end of the eighteenth century, when the Irish Parliament reduced the excise duty on ales and stouts and increased that on spirits, thus favoring the brewing industry, which has gradually expanded into one of the largest in the world. Biscuit manufacturing, on the other hand, is of more recent origin and is largely due to individual enterprise. Food processing as a whole now employs nearly 8000 workers. Other major industries are distilling, printing and papermaking, bacon curing, flour milling, tobacco manufacturing, and the building of railroad locomotives and rolling stock. The manufacture of clothing, however, including boots and shoes, gives more employment than any other single industry, but there are no large factories, and the 12,000 workers are distributed among many small establishments throughout the city. The manufacture of mineral waters, soap, chemicals, paint, furniture, metalwork, and brushes, the last industry an introduction from France by the Huguenots, is also of importance. Since 1922 the taxes imposed on practically all types of manufactured goods have led to the import of parts and their assembly in the city, especially by the motorcar traders. Most of the assembly plants are located near the docks.

In spite of the steady outward movement of population from the center of the city to the new housing estates on the outskirts, there has not yet been any substantial outward movement of factories. This is partly because land reclamation in Dublin Bay is continually producing new and convenient sites close to the heart of the city. However, the large population in the suburbs is a source of manpower that should encourage industrial development there in the future, though it seems that Dublin, in spite of its many advantages, is unlikely to become highly industrialized; the government wishes to disperse new factories throughout the country, using the electric power available everywhere on the national grid.

The tourist trade is another source of employment. Shops, historic buildings, museums, art galleries, theaters, and other places of entertainment make Dublin an attractive center for visitors, who are catered to by numerous hotels, boarding houses, and restaurants; but the 96 hotels listed by the Irish Tourist Board, with accommodation for about 5000 guests, are inadequate for present-day needs. Many visitors to Dublin from the rural areas combine shopping tours with attendance at the great agricultural shows held in May and August by the Royal Dublin Society. The Horse Show, in August, is the main social event of the year.

Functional Areas: The Urban Belt

Analysis of the land-use map (Fig. 11) reveals a division of the city into two main parts: a closely built-up urban center surrounded by a more open, newer residential belt. Within these two belts there is considerable diversity, and several smaller, well-defined, but interrelated functional areas can be recognized.

Commercial Core and Shopping Zone

The commercial core of the city occupies the east-west line of College Green and Dame Street and extends northward to the river along several narrow north-south streets. Within this area are many business offices, the headquarters of banks and insurance companies, the offices of lawyers, stockbrokers, and accountants, wholesale and retail shops, and several hotels and restaurants. Nearly all the buildings were constructed for their present purposes and are large, decorative, and well kept. Because of corporation building regulations, few are more than four stories high. This area is almost completely nonresidential.

More than 19,000 people are employed in the shops of Dublin, 26 per cent of all those so employed throughout the country. The main shopping center runs north and south from the commercial core (Fig. 2). The larger shops sell a wide range of goods and occupy several floors; the smaller ones tend to specialize. Most of Eire's luxury trade is concentrated in Dublin, and many of the smaller shops are surprisingly expensive. In addition, there are restaurants, cinemas, and hotels, the last often occupying the upper stories over the shops. Crossing this main north-south thoroughfare are a number of east-west streets catering to a less exclusive trade. Northwest of the shopping zone, street vendors with improvised barrows and stalls carry on a retail trade in perishable goods (Fig. 3). The most striking of the east-west thoroughfares are the quays that border the Liffey (Fig. 4). Near O'Connell Bridge are shops dealing chiefly in furniture and second-hand goods, but westward they merge into residential property of a humble type. It is worth noting that in Dublin, in contrast with most cities in the British Isles, the shops and houses are poorest in the western part where the oldest buildings are to be found.

The Port

The part of Dublin concerned primarily with the activities of the port lies on reclaimed land immediately to the east of the commercial and shopping areas. It includes the quays bordering the Liffey and three basins: one

formed by the Royal Canal where it enters from the north; a second, where the Grand Canal and the River Dodder enter from the south at Ringsend (Fig. 5); and a third, the deep-water Alexandra Basin, still being extended. Activities are largely concerned with the cross-channel trade. The north side of the Liffey, well served with railroads, has the larger part of the traffic and deals with practically all the livestock sent out through the port. On this side, too, the Alexandra Basin has a sufficient depth of water to accommodate transatlantic shipping and has warehouses, grain silos, petrol storage tanks, and a graving dock, which is too small, however, for modern needs. Here also is the terminus of a daily passenger service between Dublin and Liverpool, though many visitors prefer to travel by the shorter route, Holyhead to Dun Laoghaire, and complete their journey to Dublin by train.

The south side of the river lacks good rail connections but has a number of small factories depending on imported raw materials. Coal is landed here for local distribution by road and also for the gasworks near the quayside. The electricity generating station, which occupies the site of the old Pigeon House Fort about a mile out in the bay on the South Wall, has its own harbor and coal discharging apparatus. The dominance of Dublin as a port in Eire may be seen in the fact that the 5375 vessels arriving in 1939 represented a net tonnage of 2,735,624, or 44 per cent of the total for the whole country. The number includes all cross-channel steamers, oil and grain ships from abroad, and coastwise traffic but not the transatlantic passenger liners.[8] The smaller Irish ports suffer severely from the competition of Dublin.

In early times seagoing ships penetrated at least as far west as Merchants' Quay, near the center of the growing town, but the building of bridges across the river nearer the sea has limited its use there to a few steam barges carrying stout and porter and has caused an eastward shift of activities into the bay as land reclamation continues. The port is, perhaps, the most homogeneous functional area in Dublin; it turns its back on the other parts of the town.

City Residential Zone

The city residential zone consists mainly of streets of large, austere-looking brick houses, most of which were erected in the latter half of the eighteenth century, when Dublin was the second city of the British Empire and one of Europe's foremost society centers. The section immediately southeast of the city center has remained a favored residential locality, but by far the greater part, in the north and west, is decayed, unhealthful, and

[8] *Statistical Abstract, 1941,* Dept. of Industry and Commerce, Dublin, p. 157. These figures do not include Northern Ireland.

overcrowded. An inquiry in 1938 showed that in the city as a whole 111,950 persons were living in 6307 houses, an average of 18 persons to a house; 70 per cent of these families occupied only a single room.[9] These tenements are Dublin's greatest social problem. The efforts to renovate them or replace them with blocks of modern flats are now gradually changing the appearance of this part of the city (Fig. 14), but the fundamental problem of overcrowding can be solved only by moving many of the residents to the new housing estates on the outskirts.[10] Numerous small shops, widely scattered through the area, supply food and clothing, and there are several well-defined shopping areas along the more important streets leading from the center of the city. South of the river, within this zone, are some of Dublin's larger factories, which, with many smaller ones, provide employment for most of the residents.

Houses throughout the poorer belt show but faint traces of their former glory. In the south and southeast, however, similar houses are still in their prime (Fig. 7); their preservation has been largely due to the housing needs of the professional classes—doctors, dentists, solicitors—and also to the presence of numerous government buildings and offices. In some of the Georgian streets houses have been converted into flats; other streets have a large variety of hotels and boarding houses. There is an air of spaciousness about this district, due partly to the wide streets but also to the small parks that occupy Fitzwilliam Square, Merrion Square, and St. Stephen's Green. Within this area, too, are the two universities, the Royal Irish Academy, the Institute of Advanced Studies, various museums, the National Art Gallery, and the headquarters of many learned societies.

The Suburban Belt

The densely peopled town area just described is surrounded on three sides by residential suburbs, in which the houses are smaller and more openly spaced than in the city and possess gardens of various sizes. The earlier suburban developments, some of which are marked by the Georgian tradition of stately terraces and wide, tree-lined roads, lie to the northeast and southeast on low ground near the shores of Dublin Bay. The city also expanded northward and southward along the main roads but not westward, since the Phoenix Park, dedicated to the use of Dubliners for all time, hindered such

[9] Report of Inquiry into the Housing of the Working Classes of the City of Dublin, 1939–43. Cf. Whitelaw's census of 1798, which gives, in four parishes, 4512 houses with 58, 963 inhabitants; i.e. 13 to a house.

[10] J. E. Canavan: Slum Clearance in Dublin, *Journ. Statist. and Social Inquiry Soc. of Ireland,* Vol. 16, 1937, pp. 21–28.

development. Even now the west end of the park lies in open country, and it brings its green sward and playing fields, which border the three-mile-long central avenue, within little more than a mile of the city center. It is used for recreation and sport of all kinds and contains a polo ground, a zoological garden, the Peoples Garden, and the residences of the President of Eire, the American Minister, and the Papal Nuncio; not far away are a military barracks and the Ordnance Survey department.

Northeast of Dublin, Raheny and Clontarf are residential suburbs of no particular distinction. Most of the houses are of medium size, some in terraces, some semidetached, but all possessing some kind of garden in front and at the rear. They are occupied by clerks, office workers, and business and professional men, who travel to the city daily. As the suburbs were not planned at any one time, there is a wide variety of house types and a tendency toward ribbon development.

Phibsborough and Drumcondra, north of the city, have a more mixed type of suburban housing and well-developed shopping centers. The older buildings range from terraces of five-room houses to those with seven or eight rooms, but the most striking feature of this area is recent building of well-planned large estates with small two-story houses. The largest of these building schemes, Cabra, northwest of Phibsborough, was built by the Dublin Corporation to house people from the city slums. It occupies a favorable position on rising ground less than a mile and a half from the center of Dublin. Other planned residential suburbs are farther from the city and have a better type of housing. In planning these modern dormitories provision has been made for playgrounds, parks, and the building of churches and schools. A railroad passes through this whole district, but it is not used for local passenger traffic, and the new housing areas are linked directly with Dublin by motorbus.

At Crumlin (Fig. 15), a large cottage suburb southwest of Dublin, 20,000 people now live on what was farmland and open country less than 15 years ago. It, too, has its own shopping centers, schools, and churches and continues to spread westward. Neither Crumlin nor Cabra has yet become a definite unit; the inhabitants still look toward the city center, from which most of them have come and in which they still work and have friends. The main road from Dublin to the southwest, which fringes the Crumlin housing estate, passes through a much older settlement of a decidedly mixed type that, in places, approaches slum conditions.

Among the south Dublin suburbs, which extend for several miles, are Rathmines (Fig. 16), Rathgar, and Terenure. These centers were largely

FIG. 14—New workers flats being erected by the Iveagh Trust to replace slum tenements near St. Patrick's Cathedral.

FIG. 15—Corporation houses on the Crumlin housing estate for people from the city slums.

FIG. 16—Suburban development in Rathmines in the Georgian tradition; a recent building to left.

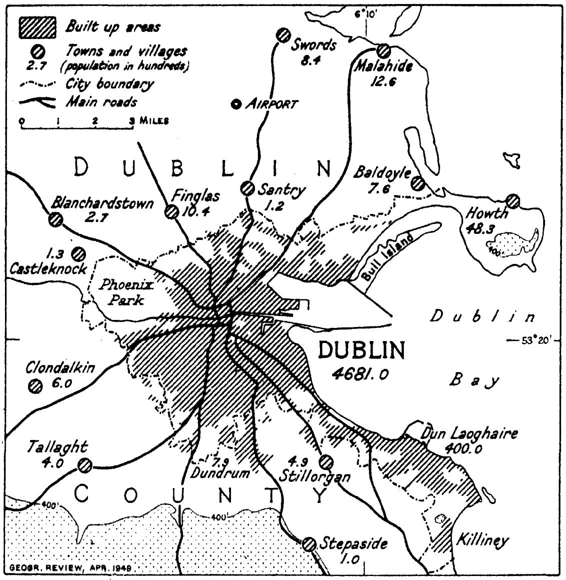


FIG. 17—The built-up areas in relation to the city boundary and the surrounding villages. Population figures from the 1936 census.

independent before they were connected with the city by electric tram in 1899, and even now, although they have been included within the boundary of Dublin City since 1930, they still have a strong measure of local organization. The type of settlement is mixed, but on the whole this is a middle-class residential district, with some larger detached houses in the southern part. Rathmines, the most important of the numerous shopping centers, has drapers, provision stores, and hardware shops and with its cinemas, technical high school, and town hall has still the appearance and function of an independent unit. Many of the larger buildings have been made into flats or boardinghouses, and some of the older Georgian houses nearer the city have been turned into tenements. This suburban area now continues, with a decreasing density of population, to the foot of the Dublin mountains at the northern end of the Leinster Chain.

Suburban development southeast of the city, outside the Grand Canal, has engulfed a number of villages and now joins Dublin with Dun Laoghaire, seven miles away on the south side of the bay. Around the old center of Ringsend, with its narrow streets and poor houses, population density is high. Elsewhere large-scale nineteenth-century building has incorporated various villages within the suburban network, and they are now joined by broad, well-planned, tree-lined roads with large terraced houses. The villages have been transformed into modern shopping centers. Ballsbridge on the Dodder, is the site of the Royal Dublin Society's show grounds and headquarters of the Irish Hospitals Sweepstakes; Donnybrook, once notorious for its riotous fairs, is now the center of an expensive residential district. The suburbs extend along the bay to Dun Laoghaire, a governmentally independent entity only recently included within the city boundaries.

The Villages

There is no clear edge to Dublin, and the suburbs grade into a farmed countryside, especially in the south (Fig. 17). The influence of the city on the surrounding areas is expressed in two ways: first, by the gradual development of various villages into suburbs or dormitory centers; second, by the dominance of dairy farming for town milk supplies, together with market gardening. Many of the villages are still rural in appearance and, although connected with the city by good bus and train services, have a strong local life, with their own shops, schools, libraries, and village halls. In some of them the new houses of the city people still seem exotic additions, but others—Malahide and Howth on the north, Dun Laoghaire, Dalkey, Killiney, and Bray on the south—are actively commercialized through the trade of week-end visitors and tourists making a more prolonged stay.

Dublin's earliest character was that of a foreign settlement in a hostile country, but its favorable position in relation to the rest of Ireland led to its adoption as the capital. Through the centuries it gradually lost its alien character, and, although still a cosmopolitan city, it is now fully accepted as the center of Irish national life. It bears the imprint of its three phases of growth: the first, in a few historic buildings and a very few houses; the second, clearly marked near the center; and the third, in the suburbs that now spread outward in all directions. Like most large towns, it is multifunctional, a diversified city;[11] it is at once a regional and political capital and a cultural, professional, financial, and residential center. Its wide streets, the infinite variety and beauty of the surrounding country, and the genial outlook and vitality of its inhabitants all lend to this metropolis of Ireland a distinction and charm possessed by few other great cities.

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[11] See C. D. Harris: A Functional Classification of Cities in the United States, *Geogr. Rev.*, Vol. 33, 1943, pp. 86–99.

MALARIA, IRRIGATION, AND SOIL EROSION IN CENTRAL SYRIA

NORMAN N. LEWIS

THIS study of the Selemiya region of central Syria had its origin in a modest wartime public-health program. Hundreds of patients suffering from malaria in the villages of this district were regularly treated by a mobile clinic, and it soon became obvious that this work had to be supplemented if not replaced by swamp drainage and other measures of malaria control. The necessary investigations showed that soil erosion in the hills in the east of the region was partly responsible for the swamps on the plain. The swamps themselves were frequently associated with ancient irrigation works. Thus various problems of the region—agricultural, social, and medical—were closely linked in origin and development. It was found that attempts to solve any one of them alone could not be more than partially successful, and the conclusion reached was that the ideal solution would have to be radical, comprehensive, and on a large-scale regional basis.

THE LANDSCAPE

The greater part of the governmental subdistrict (caza) of Selemiya is a plain. Bounding it sharply on the west are low plateaus, capped by a level bed of basalt a few feet thick; to the southeast are ranges of hills, part of the Palmyrene group, to which the local collective name of Jebel Bil'as may be given.

The ground slope over much of the region is toward the town of Selemiya; drainage from an area of 620 square miles converges on the low flat land around the town. Because of the continuous subsurface flow, a perennial stream rises at Ain ez Zerqa, to flow 12 miles to the west to join the Orontes. All other perennial streams, however, are only a few hundred or thousand yards long and are used for irrigation; most of them rise in artificial underground channels. Most of the watercourses are wadis, dry or nearly dry for much of the year. In the hills these are steep, V-shaped valleys, on the plain generally wide, shallow, gravel-filled channels in gentle, open valleys.

Figure 2 gives a simplified indication of the configuration. Hydrologically, the strata may be simply grouped into the Cretaceous limestones

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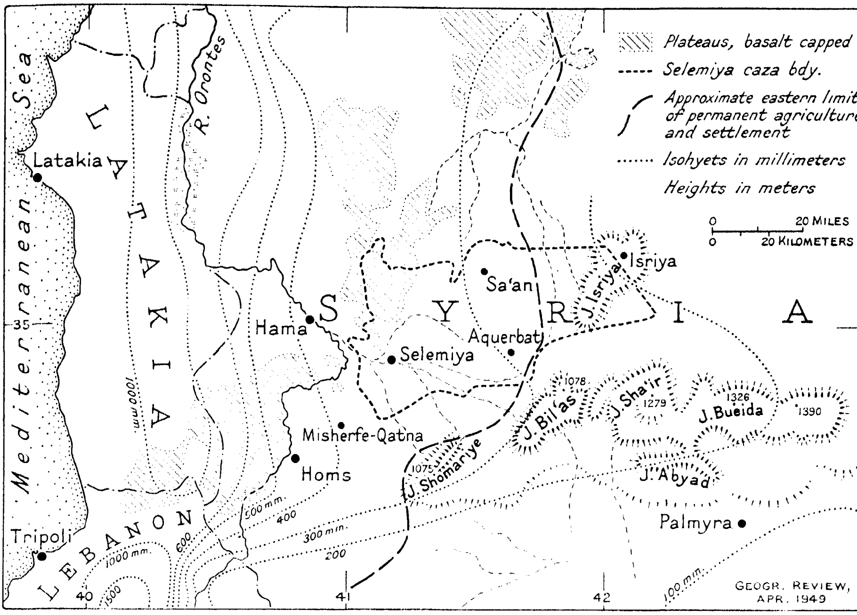

FIG. 1—The Selemiya area in its general setting. The hills are frequently given the collective name of Jebel Bil'as. Isohyets are from Charles Combier: Aperçu sur les climats de la Syrie et du Liban, avec carte au millionième des pluies et vents, Délégation Générale de France au Levant, Beirut, 1945. Spelling of the place names here and in the text in general follows the (British) Permanent Committee on Geographical Names.

of the hills and the Eocene-Oligocene marl of the plain. The limestones are predominantly pervious dolomitic limestones, separated by more or less impervious beds of flint and marl. Winter rainfall runs off in the wadis or soaks into the ground and either is soon discharged at a lower level by temporary springs or seeps slowly toward the plain, assisted by the dip of the strata.

The marl of the plain is in its unaltered state impermeable, but usually it has been affected to a considerable depth by the percolation of water through cracks and fissures. In this way calcium carbonate and silica are deposited to depths of as much as 50 feet, and the whole character of the rock is altered.[1] It becomes crumbly, permeable, and water-bearing. Above this layer of rock a hardpan develops, ranging in thickness from a few inches to four feet, which is due to the concentration by capillary action of calcium carbonate and silica.

The region is one where the desert merges into the sown. The rainfall

[1] L. Dubertret: Lithological Map of the Eastern Border of the Mediterranean, 1 : 500,000, with notes translated by W. B. Fish [i.e. Fisher], Fighting French Delegation General in the Levant, Geological Section, Beirut, 1943.

regimen is Mediterranean in type, practically all the precipitation falling in winter, the summer being characterized by drought and great heat. In the east the rainfall is sporadic and unreliable and in most years is less in total quantity than in the west. Selemiya has a mean annual rainfall of 344 millimeters (13.5 inches). On the west-facing slopes of Jebel Bil'as rainfall is relatively heavy, though highly variable, and it permits tree growth. The present eastern limit of close agricultural settlement and of permanent unirrigated cultivation is near the 200-millimeter isohyet;[2] it was approximately the same in Romano-Byzantine times. Any further extension of agriculture to the east would mean great risk of crop failure and of increased soil erosion by wind and water.

In the cultivated west the soil is heavy and clayey, but farther to the east it is light and friable, with a high sand content and practically no humus. In Jebel Bil'as the soil is intermediate between these two types, liable to erosion by wind in summer and water in winter.

Over the greater part of the region the two main elements in the natural vegetation are low xerophilous scrub[2] and ephemeral grasses which appear in early spring and wither away in summer. The roots and rootlets of both the permanent scrub and the annual vegetation help hold the soil in place. In Jebel Bil'as these types of vegetation are well developed, and the hills are favorite spring pasture grounds for the sheep of peasants and Bedouins. Isolated trees grow in the Palmyrene ranges far to the east throughout the area within the 200-millimeter isohyet, and even just to the east of it, in country believed to have a mean annual rainfall of less than 200 millimeters (7.9 inches). On the northwestern slopes of Jebel Bil'as tree growth is more abundant. Nothing demonstrates better the positive rainfall anomaly of the hills as compared with the arid plains to the north and south.

At the present time the landscape of Jebel Bil'as is at the best parklike, the trees being scattered, except in the valleys, where clumps of three or four grow together. Few trees are taller than 20 feet. The *Pistacia* genus is represented by *P. terebinthus* (probably *P. palaestina*) and *P. vera* (the pistachio tree). The wood of these two trees, hard and slow-burning, is much valued as a fuel. Scrub oak also occurs, and in wadi bottoms thick-leaved evergreens. Shrubs and herbaceous plants are scattered everywhere.

Irrigation

The long summer drought makes irrigation necessary for most crops

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[2] A full account is given by M. Zohary: ~~Geobotanical~~ Analysis of the Syrian Desert, *Palestine Journ. of Botany*, Jerusalem Ser., Vol. 2, 1940, pp. 46–96.

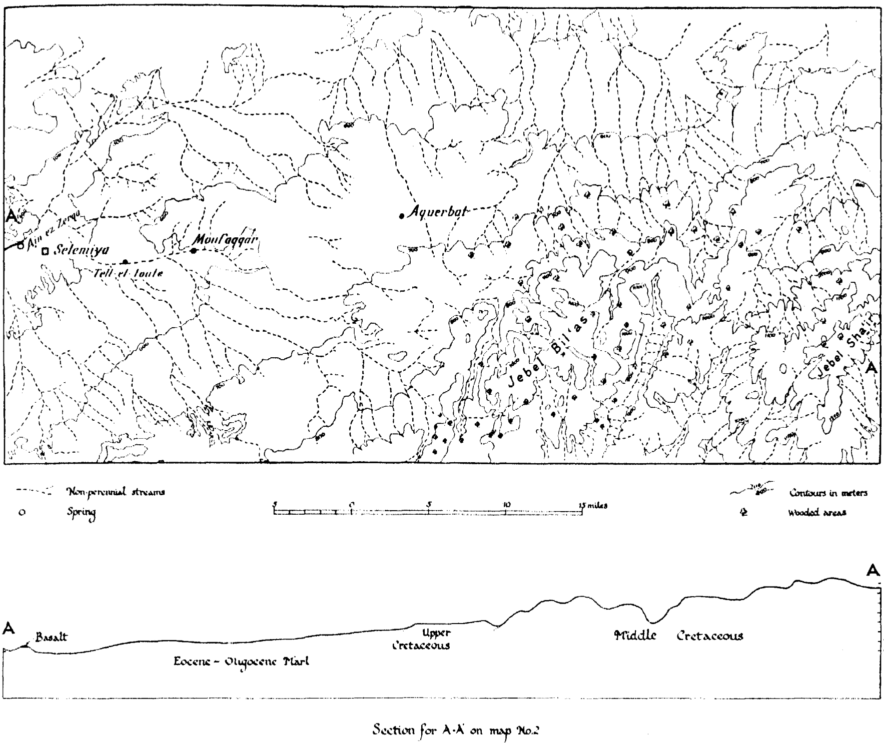

FIG. 2—Topographic map and cross section of the country east of Selemiya.

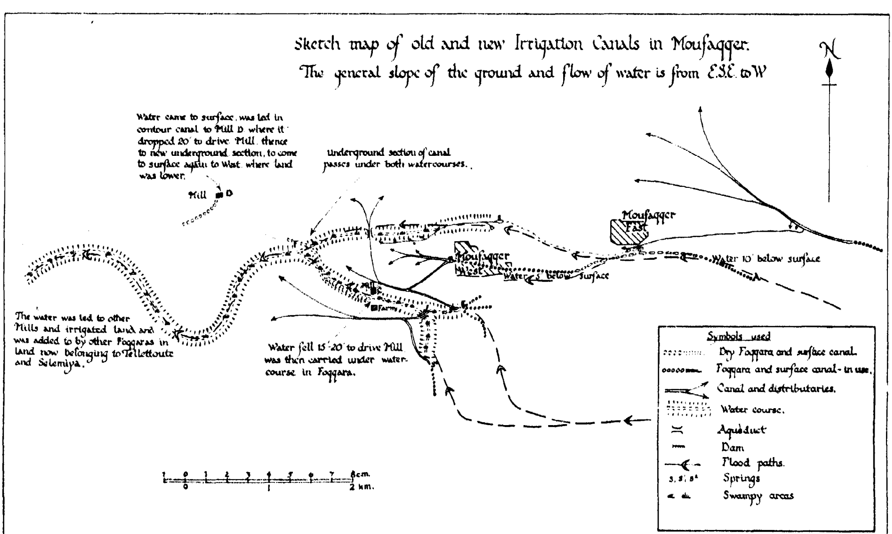

FIG. 3—The irrigation system of Moufaqqar, east of Selemiya (see Fig. 2).

except wheat and barley, and around each village is an area of irrigated land on which vegetables, fruit, cotton, maize, fodder, and grain are grown. The configuration of the ground and the peculiar properties of the marl make possible the use of subsurface water for irrigation, and past and present inhabitants have taken full advantage of these conditions.

Water is distributed to irrigation ditches from wells, surface watercourses, or *foggaras* (foqqaras).[3] It is lifted from wells either by pumps or by chains of buckets geared to an animal-turned wheel. From wadis which have water in part of their course for some or all of the growing season it is taken by a gravity canal. The stream is roughly dammed and the water led, at a gentler angle than that of the watercourse, along the valley side until it reaches a suitable level for watering the ground below. Neither of these methods is of great importance as compared with foggaras, which supply most of the irrigated lands of the area.

A foggara, known elsewhere as *qanat, kariz,* or "chain of wells," is an underground conduit. The method has been used since ancient times in many parts of the Middle East. Foggaras are found in several regions of Syria and are especially numerous in the Selemiya region. Figure 4 shows the general principle by which the water-bearing layer is tapped by the gallery or subsurface canal. The most copious supplies of water are provided when the canal is driven back from a spring along the underground "stream" that feeds it. A depression that is a natural gathering ground of water is often utilized, or a wide area may be tapped by the construction of several converging galleries, as in Moufaqqar. The gradient of the gallery is sufficient to induce water flow, but it is less steep than the general slope of the ground, so that water is conducted gradually to the surface, usually to low-lying flat land suitable for irrigation. The vertical shafts, like large wells, which connect the underground canal to the surface, were used during the digging as passages of ingress and egress and serve the same purpose now when the canals are cleaned of mud, debris, and vegetation; hence they are always surrounded with mounds of accumulated spoil. Lower down, as the canal comes to the surface, it flows between steep banks, which gradually become less high, until the water is flowing at ground level. Often the hardpan forms a natural roof to the gallery.

In length, depth, and water flow the foggaras differ greatly. One canal

[3] Foggaras in North Africa have been described and illustrated in the *Geographical Review*. See Jules Blache: Modes of Life in the Moroccan Countryside, Vol. 11, 1921, pp. 477–502, references on pp. 488 and 491; R. H. Forbes: The Transsaharan Conquest, Vol. 33, 1943, pp. 197–213, reference on p. 199—EDIT. NOTE.

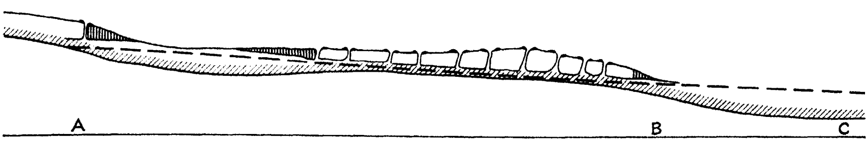

FIG. 4—Vertical section of a foggara. The diagonal shading represents the water-bearing level in the altered marl, below which is unaltered impervious marl. The gallery A to B taps the water-bearing layer at its upper end and in the center. Water in the gallery is represented by the dashed line. The irrigated area extends from B to C. The vertical shading represents the part of the canal between steep banks.

FIG. 5—Upper part of one of the Moufaqqar canals (see Fig. 3). Photograph from a position corresponding to B above, where the canal is formed by steep banks. Parts of natural roof are formed by the hard pan, clearly distinguishable from the bed of crumbly altered marl below. Until 1945 the canal was semi-derelict, filled with mud, vegetation, and flood detritus (see foreground). When the cleaning was completed, the canal was approximately doubled in depth and a strong stream of clear water flowed in the bottom. (Photograph by John Gough.)

was built, probably in the Roman period, to carry water from Selemiya to Apamea, more than 50 miles away. This was an exception, dug to carry drinking water to a city, but some of the canals which capture and supply irrigation water in the Selemiya plain are several miles in length; one, starting in Moufaqqar, was originally seven miles long. Others are only a few hundred yards in length.

The quantity of water delivered by the canals in use today is estimated

locally by the area of land each irrigates. One canal irrigates 136 acres near Selemiya town; many supply between 20 and 60 acres; and the smallest suffices only for 2.4 acres (near Tell et Tout). The larger canals are nearly all in the low-lying basinlike plain around the town of Selemiya; most of the smaller ones lie toward the northeast. A canal which supplies 68 acres of land in Selemiya delivers 8.8 gallons a second (measured at lowest water level, in October, 1945). There are today in the caza 125 such canals which are in working order and an unknown number which are not in use. These 125 canals irrigate a total of 3060 acres. The map of Moufaqqar (Fig. 3) shows typical modifications and elaborations of the foggara.[4]

HISTORY

At Misherfe-Qatna, where a modern village occupies the site of a Hittite fortress-city, 18 miles southwest of Selemiya, a foggara-like canal supplied the town in the second millennium before Christ.[5] Most of those in our region date from a much later period, and probably more were constructed from the second century of our era to the sixth than at any other time. Many can be dated by the details of their construction, or by their close association with ruins, or, occasionally, by inscriptions. During these centuries the Selemiya region was a prosperous agricultural district, well supplied with irrigation water. The Roman legacy was added to in the early period of Arab rule,[6] when Selemiya was well known as a pleasant country town, the public buildings of which, especially the baths, rivaled those in great Arab cities. Descendants of the Abbasid Prince Saleh ibn Ali ibn Abdullah ibn Abbas ibn il Motalib lived in Selemiya, and, according to Ya'qubi, writing in 891, Abdullah, the son of Saleh, "conducted thither a stream of water, and dug wells in the land, whereby the saffron grows plentifully." For a period after 893 the town became a center of the Ismaili sect, a circumstance which brought it importance then, and which was to affect the region powerfully a thousand years later.

Throughout the Arab period the water of Selemiya remained famous. As late as the fourteenth century Ahmed the Secretary praised Selemiya as "a charming and rich town, with abundant water and trees. Water comes

[4] See the maps of Qdeym for typical modifications and elaborations of the foggara, Plans III and IV in the atlas volume of R. Mouterde and A. Poidebard: Le limes de Chalcis: Organisation de la steppe en Haute Syrie romaine (Bibliothèque Archéologique et Historique, Vol. 38), 2 vols. (text and atlas), Paris, 1945. See review elsewhere in this number of the *Geographical Review*.

[5] Mesnil du Buisson: Le site archéologique de Michrife-Qatna, Paris, 1935.

[6] Information on the Arab period is drawn largely from the article "Salamiya" in the Encyclopaedia of Islam and from Guy le Strange: Palestine under the Moslems, Boston and New York, 1890. The quotation from Ya'qubi is from Le Strange, p. 528.

to it in aqueducts."[7] Today there are 39 foggaras in use on the lands of Selemiya, and there are also some that are unused. Very few of the foggaras are modern, so that we may legitimately suppose about the same area to have been irrigated around the town in the Arab period as at present—1300 acres. The water was renowned for its purity, as it is today, and Hama, 18 miles away on the muddy Orontes, drank Selemiya water brought to the city by a foggara from Ain ez Zerqa. Abu el Fida (1273–1331), geographer and king of Hama, caused this canal to be cleaned, and two centuries later the following inscription from a Hama mosque shows that it was repaired or cleaned again:[8]

On fifteenth Gumada I 901 [March 2, 1496] was promulgated the princely, august decree of our master, the great emir, the chief, the governor general, Sayfaddin el Asrafi Qansuh as Sarifi as Sami, governor general of the province of Hama (may God glorify his victory!), prohibiting the diversion of moneys to the profit of the exchequer (may it ever prosper!) and of others, from the funds intended for the aqueduct of Selemiya, and ordering that nothing should be taken from this fund except the wages of the workmen laboring on it. Whoever should renew these exactions, let him be accursed, and may both his father and his Prophet testify against him on judgment day.

By this time the prosperous days of Selemiya were nearly over. Scattered references show that the frontier of settlement and regular agriculture in the region was retreating westward. Tamerlane ravaged all Syria in 1400, and in 1516 the country fell to the Turks. During the next four centuries Syria slowly decayed. In the seventeenth and eighteenth centuries several great Bedouin tribes moved north out of Arabia into the Syrian Desert and its peripheral regions. After this the steppe and the desert were almost completely beyond the control of the Turkish government, and the frontiers of law, order, and settled life retreated from the edges of these uncontrolled territories. The valuable journals of some English merchants[9] who traveled through the eastern part of our region at the end of the seventeenth century show that, except for Bedouins, it was then practically deserted. The Ismaili inhabitants, according to their descendants' tradition, had left soon after

[7] See [Maurice] Gaudefroy-Demombynes: La Syrie à l'époque des Mamelouks (Bibliothèque Archéologique et Historique, Vol. 3), Paris, 1923, pp. 77–78.

[8] This inscription is from the Great Mosque of Hama, where there are a number of Mameluke decrees, dealing particularly with trade and taxation. It is transcribed in French by Jean Sauvaget in *Bulletin d'Études Orientales de l'Institut Français de Damas*, Vol. 3, 1933, p. 6.

[9] "An Extract of the Journals of Two Several Voyages of the English Merchants of the Factory of Aleppo, to Tadmor, Anciently Call'd Palmyra," *Philos. Trans. Royal Soc. of London*, No. 218, Vol. 19, 1695, pp. 129–147. [Also in "Miscellanea Curiosa," Vol. 3, Containing a Collection of Curious Travels, Voyages, and Natural Histories of Countries, As They Have Been Delivered in to the Royal Society, 2nd edit., revised and corrected by W. Derham, London, 1727 (originally edited by Edmund Halley in 1708), pp. 120–159.]

Tamerlane's invasion and were dispersed in other parts of Syria. Of 3200 villages once on the tax rolls of the pashalik of Aleppo, only 400 were said to be inhabited when Volney visited the country in the 1780's.[10] Such peasants as remained in the west of our region suffered from misgovernment, extortion, and raiding by Arab tribes.

In the second half of the past century a movement of recolonization started that is still in progress. Sheep-raising Arab tribes began to settle in villages; peasants came from the districts of Hama and Homs; immigrant Circassians established four villages north of the town of Selemiya. The frontier began to move outward once more, and old foggaras were cleaned and repaired to give irrigation water once again. The strongest and most energetic immigrant group, the pioneers, were Ismaili, led back to their land of a thousand years ago by a group of powerful leaders. They settled first on the site of Selemiya itself about 1870. Today they number 14,000 or more, the majority living in the town and in villages to the east. They chose village sites where old foggaras could be brought into use, and for 75 years they have been extending the area of irrigated land by the restoration of old canals and the digging of new ones. In the last 20 years subsistence agriculture, depending largely on unirrigated grain farming, has given way before a more intensive commercial system, typified by the growing of irrigated cash crops such as seed onions and cotton on individualized holdings. The government has granted money for canal cleaning and swamp drainage. All these factors have contributed to extension of irrigation.

Some old canals, however, are still derelict. Some are so ruined that the cost of repair would be prohibitive. Others may yet be brought back into use, but the will to work is weaker than in the early days of colonization, and now laborers' wages and other expenses have increased. Elsewhere village boundaries cut across old canals. Landowners of the village where a canal rises are loath to let the water flow away to the lands of another village, and thus ancient foggara systems which were perfectly related to the physical environment have been partly replaced by more local schemes of surface canal and ditch irrigation. For example, the canals that rise in Moufaqqar (Fig. 3) could irrigate land and drive mills in Moufaqqar, Tell et Tout, and Selemiya, but they have been so modified that the water is used only in Moufaqqar, and some of it runs to waste. A canal which rises in Tell et Tout but which formerly flowed on to Selemiya land has been blocked, so that its water irrigates Tell et Tout land only.

[10] C.-F. Volney: Travels through Egypt and Syria, in the Years 1783, 1784 & 1785, translated from the French, 2 vols., New York, 1798; reference in Vol. 2, pp. 90–91.

Malaria and Its Control

Foggaras and surface canals easily become partly blocked by vegetation, and floods and rain wash in mud and silt. The water is then ponded back, depressions near the canal bank fill, the canal may overflow, and, if it is built along the side of a valley, overflow or seepage will maintain swamps along the watercourse. Artificial blockages of foggaras also pond back the water. Near the lower end of most canals are "brick pits" from which earth has been taken to be made into mud bricks, and these also tend to fill with water. Everywhere wadis carry rain and seepage water in winter and spring and the overflow from irrigation canals in early summer and autumn, at which seasons there is a surplus. In other words, except during the peak irrigation and evaporation period of midsummer, they carry slow-moving, half-stagnant water.

All these places are potential, and most of them actual, breeding places of the mosquito *Anopheles sacharovi,* which favors shallow, sunny, warm waters, full of aquatic vegetation. At only one place in the area has another malaria carrier, *A. algeriensis,* been found, and the problem of malaria control in the region is thus essentially that of eliminating the *A. sacharovi* breeding grounds. Full statistics are not available, but such figures as do exist show the great need of such control. About 20 per cent of the patients treated by a mobile clinic in the region in 1942–1945 were suffering from malaria, and the percentage rose at times (especially in late summer) to 80 in some villages. Sometimes practically the whole population of a village was found to be infected. In Tell et Tout (population *c.* 550) about 50 deaths were due primarily to malaria in 1941, and almost the sole source of infection was the swamp caused by the deliberate blockage of a foggara.

Control work is apparently simple. Canal owners occasionally clean the canals of detritus and vegetation and repair the banks at the lower end. It is important that this work be done well and repeated every few years. Small depressions may be sprayed, filled with earth, or drained by a simple ditch. Broad, sluggish streams may be canalized by a ditch along the thalweg. The more efficient the irrigation, the less likely it is that mosquitoes will breed. Waste of water should be reduced to a minimum and a wide range of crops grown, so that irrigation begins early in the season and ends late. The "waste" water of natural watercourses may be utilized by the construction of a simple dam and gravity canal, or by the repair of the old subparallel foggara if, as is probable, there is one. Extensive stretches of swampy ground may be put to good use by drainage-irrigation schemes, which often include the repair of old foggaras. Malaria control should not stand on its own, an expensive

necessity for health's sake alone, but should be part of a general *mise en valeur* of the region's resources. This is the type of approach which is most likely to succeed, because it is linked with the material interests of the landowners. They will lend their support and active participation if given technical advice, supervision, and material and financial help to defray part of the capital outlay.

SWAMPS, FLOODS, AND SOIL EROSION

Malaria-control measures were taken with a fair degree of success in 20 villages in 1944–1945. Various factors, however, combine to prevent a permanent reduction of the incidence of the disease. Among these are the necessity for constant supervision, the need for repeated cleanings of canals and ditches, and the improvidence of the inhabitants. Most important is the fact that floods will certainly undo much of the work.

Winter floods are frequently heavy enough to destroy or damage seriously the repair and maintenance works, which are of value to agriculture and malaria control alike. Malaria causes debility and apathy among the villagers, and the certainty that floods will recur reinforces this apathy, making everyone disinclined to expend energy and money in work which must be done again in a few years. The canals and watercourses at Moufaggar, for example, have been badly damaged in the past; in fact, damage by floods was the main reason for the modification of the old foggara system. The southern foggara and watercourse are now protected against torrents by a concrete wall at the upper end, but as the system lies in one of the main valleys coming from Jebel Bil'as, it is doubtful whether the device will be a great success. Although the broad, nearly flat valley north of Selemiya has benefited from its wide catchment area—it is built up of alluvium, as much as 10 feet deep—it is partly derelict because floods have created extensive swamps and ruined old foggaras. In 1945–1946 useful drainage work was undertaken here.

The floods are due in part to the occasional sudden and torrential rainstorms, characteristic of this as of other semiarid regions. Wadis are sometimes filled for a few hours with violent, detritus-laden torrents and are then left dry again. The steep slopes and absorptive limestones are contributing factors. English merchants, traveling in 1691, noted[11] that after a heavy rainstorm

> those hollow Gutts which we passed over without the least appearance of Moisture, were, by the Cataracts which descended from the Mountains, become Rivers; . . . the next Morn-

[11] "An Extract of the Journals" (*op. cit.*), p. 144 [Miscellanea Curiosa, pp. 139–140].

ing all this great quantity of Water was past away, so that in about two Hour's Riding we could hardly perceive that there had been any Rain at all.

That floods are an old phenomenon in Selemiya is suggested by two traditional theories, repeated by the inhabitants today, regarding the derivation of the place name. The first theory makes the essential form Sal-Miah, "a flood of water." The other was recorded by Yaqut in 1225:

Ahmad ibn Yahyâ ibn Jâbir relates that there was a city in Syria, near Salamiyyah, called Al Mûtafikah [The Overturned], which was overwhelmed with all its inhabitants—all except one hundred souls. These left that place, and came and built one hundred houses, and they called the hamlet where they had made their houses Salâm Miyah (Peace for the Hundred), of which the people made Salamiyyah.[12]

As told today, the story is that the "overwhelming" agent was a flood.

The floods are greatly aggravated by soil erosion. Where the trees have been cut, the bushes torn up for fuel, and the grass overgrazed, and especially where slopes have been plowed, there the soil is eroded, and many slopes are now practically bare of soil and vegetation. In summer, soil is shifted by strong winds; in winter, rain washes it into gullies or wadis with steep, crumbling sides. These are tributary to the main streams which do so much damage when they reach the plain. The runoff from bare slopes is faster and more fully loaded than that from vegetated slopes.

Past and Present Vegetation Destruction

There is no doubt that the trees of Jebel Bil'as are a remnant of a denser and more extensive growth, though there are no very good grounds for the common assumption that all the Palmyrene ranges were forested in Roman days. The Tablet of Palmyra's fiscal laws of A.D. 137[13] gives reason to suppose that the locality may have furnished considerable quantities of wood and pistachio nuts, and in the same period Jebel Bil'as and neighboring ranges were used as grazing lands for sheep and horses.[14] The location of elaborate Romano-Byzantine foggara systems, as at Moufaqqar, directly in the paths of the floods might seem to indicate that, when the foggaras were constructed, floods were not as serious as they are now.

Old stumps and roots are found within and beyond the present wooded

[12] Le Strange, *op. cit.*, p. 510.

[13] See J.-B. Chabot: Choix d'inscriptions de Palmyre, Paris, 1922, pp. 23–38.

[14] A. Poidebard: La trace de Rome dans le désert de Syrie.—Le limes de Trajan à la conquête arabe.—Recherches aériennes (1925–1932) (Bibliothèque Archéologique et Historique, Vol. 18), Paris, 1934; M. D. Schlumberger: Une campagne de fouilles au Djebel-el-Chaar en 1934, *Comptes Rendus de l'Acad. des Inscriptions et Belles-Lettres*, 1935, pp. 250–256.

area. The English merchants who passed through the hills in 1678 noted that Jebel Bil'as was "covered with Trees, which, for the most Part, were the small *Pistacho*'s which the *Arabs* pickle with Salt; but eaten green, are good to quench Thirst"; and in 1691 they ascended a ridge to the east of Jebel Bil'as where the tree cover is now sparse and found it "cover'd on both Sides with great plenty of Turpentine-Trees," which grew "very thick and shady," several of them "loaded with a vast Abundance of a small round Nut."[15]

In spring, when surface water is available and the pasture is excellent, the hills are full of flocks; and several hundred thousand sheep, together with some goats and camels, pasturing each year for about three months cause much damage. Bedouin and peasant shepherd families burn vegetation on the spot, and woodcutters from Selemiya and the villages cut large amounts of the valued slow-burning pistachio wood. Vegetation has been destroyed in these ways since prehistoric times, but at certain periods the process has been quickened. Between 1914 and 1918 the Turkish authorities took great quantities of wood as fuel for the railroads. Local notables say that within living memory trees extended beyond Aquerbat; that is, several miles into the country now cultivated and treeless. The westernmost range, Jebel Shomariye, has lost all its woods, and a ridge to the east, which was "overgrown in some places" with terebinth trees in 1908,[16] is today bare. A new danger to the soil of the hills has resulted from the high grain prices now prevailing, the growing population pressure in the region, and the tendency of Arab tribes to settle down to agriculture; for now increasing areas of land on the western fringe of the hills are being plowed.

Malaria control on the plain must clearly be accompanied by soil conservation in the hills, and, ideally, both should be part of a larger scheme of regional rehabilitation. Such a scheme would cover, among other matters, irrigation, malaria control, vegetation conservation, farming practices, and grazing rights. It would mean radical changes in the region; it would require a large capital outlay; and it would necessitate government action of a scale and vigor practically unknown in Syria. It is impossible to discuss here whether such a scheme would be economically justifiable, or possible within the present social and political framework. One can only emphasize that some such comprehensive action must eventually be taken if the problems of the region are to be solved.

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[15] "An Extract of the Journals" (*op. cit.*), pp. 132 and 143 [Miscellanea Curiosa, pp. 123 and 137–138].

[16] Alois Musil: Palmyrena, *Amer. Geogr. Soc. ~~Oriental~~ Explorations and Studies No. 4*, 1928, p. 44.

FREQUENCY AND DISTRIBUTION OF DEW IN PALESTINE

D. ASHBEL

DEW is a major factor in the water balance of the vegetation of Palestine, a subtropical country with a rainless summer.[1] Before its importance is evaluated, the nature of dewfall must be briefly recalled. Dew forms on the outer surfaces of objects susceptible to free cooling by nocturnal radiation. It also forms in the free air at a short distance from the earth's surface by condensation on small floating dust particles, which thus increased in weight are forced down to the ground. After a night of dewfall one sees on various surfaces polygonal figures, the sides of which are formed from dust particles adhering together and distorted by surface tension.

An important practical distinction should be made between rain and dew and between fog and dew. Rain is measured on a horizontal surface; dew, since it forms on all exposed surfaces, must be measured "all round." Fog "creeps" along the ground, dampening surfaces in the direction of its flow. Dew and fog should be carefully differentiated in meteorological observations, particularly where fogs play an important role in the formation of atmospheric water. In the Valley of Jezreel and in the Negeb fog is formed by large numbers of dewdrops condensed around dust particles that remain hovering in the air. At Menara, in Upper Galilee, the fog is actually a cloud settled on the ground. These fogs have no less, perhaps even greater, hydrological importance, especially in this hilly region, which is generally poor in dew.

Dewdrops differ in size and in number; hence the quantity of water formed on the surfaces of an object varies. The largest quantity forms on the side facing upward. This "upper dew" must be distinguished from the dew that forms on the surface facing the ground when there is sufficient moisture in the earth for evaporation in the night. Such dew is to be found in winter, and in irrigated areas in summer also, if there is sufficient cooling off in the night. The influence of irrigation is illustrated around the Sea of Galilee (212 meters below sea level), where in the dry months irrigated places have dewfalls and unirrigated places have no dew at all.

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[1] See also D. Ashbel: On the Importance of Dew in Palestine, *Journ. Palestine Oriental Soc.*, Vol. 16, 1936, pp. 316–321, and the references listed therein.

➤ DR. ASHBEL is head of the Department of Meteorology at the Hebrew University of Jerusalem and the author of several works on the climate of Palestine and the Middle East.

For the formation of dew, complete exposure of surface is necessary. That is why the inner leaves of trees are dry. Neither do the inner areas of stone heaps and rocks in the ground need to be considered. Everything that has been written so far on the formation of dew in appreciable quantities "within" stone heaps (dew wells) requires clarification. The exact purpose of the installations in the Crimean peninsula described some twenty years ago as "dew wells" is not known. If we must speak of "dew wells," we might take as an example those in the desert of Northwest Africa.[2] These are buildings with a large roof surface on which dew forms during the night and drops down into a reservoir protected during the day against the sun's rays and undue evaporation. No large amount of water is to be expected in such reservoirs; but where no drinking water whatever is available, the few liters collected every night is invaluable to thirsty wayfarers.

Systems of Dew Measurement

The measurement of dewfall presents certain difficulties. Since the amount of dew that condenses on an object is proportionate to the rate of cooling off, it will therefore vary with the object. The rate of cooling of a metal sheet is not the same as that of a wooden board, nor is that of a long, thin body free in the air the same as that of a thick one not free. Measurements on leaves of plants of different genera show different quantities of dew. The bulb, cereal, and rose families condense vast quantities; conifers, particularly the cypress and the thuja, are very poor in dew. The problem, then, is to find an indicator that gives standard and comparable results.

Some dew gauges are made of thin metal foil, with or without a covering of soot, which increases the nocturnal cooling off. The soot covering is used, for example, in the French and Italian instruments known as drosometers or roseometers. Both are constructed on the weighing principle, and the French ones (manufactured by J. Richard) are self-recording. Leick's gauge uses a plate made of a mixture of gypsum and infusorial earth, which is weighed in the evening and again in the morning after the plate has absorbed the night's dew. In Hiltner's system dew is measured by a net of horsehairs (freed of natural oil), weighed in the evening and in the morning. Nothing in nature condenses dew more readily than hair, a fact well known to the ancients. We recall, from the Song of Songs, "my head is filled with dew, and my locks with the drops of the night"; and Gideon and the fleece in the Valley of Jezreel (Judges, Chapter 6). A system of measurement in

[2] Cf. Jean Gottmann: New Facts and Some Reflections on the Sahara, *Geogr. Rev.*, Vol. 32, 1942, pp. 659–662; reference on p. 660.

vogue in South Africa employs a sheet of glass of fixed size; the dew formed on the upper surface is gathered in the morning in blotting paper and weighed. Duvdevani's dew gauge[3] employs a plaque of wood painted with oil paint, which is read optically, according to the form of the drops, with the aid of an album of photographs. Optical reading has been used by the Meteorological Department of the Hebrew University since 1933; the innovation is the painted wooden plaque. In the Negeb dew formed during the night on the tin roofs of the dwellings is collected through spouts into special vessels. The amount of water gathered in this way is so great that it can be measured in a measuring glass, recorded, and graphed.

From the automatic humidity recorder some idea of the number of dew hours every night can be obtained. This method is used at stations—40 in number—all over the country. Improvements in the observations have been effected by classifying the dew amounts in three categories: little, medium, and much. It has been discovered that several regions which have about the same number of dewy nights differ as regards classification.

Study of soil temperatures also contributes to the problem. Since dew formation is dependent on the rate of cooling, it is important to know the daily ranges of the soil temperatures. Differences of 48° C. (65°–17°) in summer have been recorded on the surface in the hill region, 33° (55°–22°) in the coastal plain, and 25° (50°–25°) in the Jordan Valley. At a depth of 10 centimeters the daily range drops to a tenth of that at the surface; at 30 centimeters it does not exceed 2°; and at half a meter it is only several tenths of a degree. It should be stressed that on the surface the maximum temperature is at noon and the minimum toward the end of the night but inside the soil the maximum and minimum temperatures are retarded. At a depth of 25 centimeters the maximum is reached at midnight and the minimum at noon of the following day. This means that inside the soil there is almost no cooling off during the night but, on the contrary, a heating which increases as the night advances. It would seem, therefore, that the theory of cooling off and formation of dew within the soil at night is untenable. At the most, only the surface needs to be taken into account, or perhaps only a few centimeters of depth. Is it admissible, then, to say that in the depth of the soil dew is formed during the daytime?

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[3] Cf. "A Letter from Palestine" by D. H. Kallner, *Geogr. Rev.*, Vol. 37, 1947, pp. 457–460; reference on p. 460. A paper on "Dew Measurements in Israel" by Mr. Duvdevani was on the program of the annual meeting of the American Meteorological Society held in New York City January 25–28, 1949; an earlier paper "An Optical Method of Dew Estimation" together with a discussion thereon was published in the *Quarterly Journal of the Royal Meteorological* Society (Vol. 73, 1947, pp. 282–296).—Edit. Note.

There is a great difference between smooth and flat earth and rough and plowed ground. The larger the number of lumps, the greater is the contact with the air and, consequently, the possible absorption during the night. Earth plowed into large lumps has a maximum absorption of water vapor, whether by means of dew or by direct absorption.

Regional Distribution of Dew

A large amount of information has been collected from measurements carried on for 16 years, on the basis of which a map has been prepared of dew distribution in Palestine. The map differs markedly from that of rainfall. As is well known, the Negeb is the region poorest in rainfall; in dew formation, however, it is the richest in Palestine. The hill regions, on the other hand, have the largest rainfall in the country, but a smaller dew formation than the Negeb, the coastal plain, or the Valley of Jezreel. Special interest attaches to the paucity of dew at the foot of the mountains even to the west of Carmel and Upper and western Galilee, which are almost on the seacoast. This phenomenon is purely dynamic and results from the warming of the air currents that descend to the sea at night. The coincidence of a small rainfall and a small dew formation in the Jordan Valley must be ascribed to the small amount of cooling, again due to dynamic factors. The status of Mt. Carmel comes as a surprise: the idea has been current that this famous mountain has the largest dew formation, whereas the comparative figures show that, although it has the largest among hill regions, it does not stand in the forefront as far as other regions are concerned. Surprising also is the situation in the lower Beisan Valley (Tirat Tseir), where dew formation in summer is of a relatively high order, in contrast with conditions between Ain Harod and Beit Shean (Beisan). The phenomenon is explained thus: air currents descending from the west reach the floor of the valley near Beit Shean; thence they flow horizontally or even rise a little because of the nearness to the mountains of Gilead. All the factors have not yet been clarified, but a continuous recording over eight years shows that the high moisture content of the night air in this particular part of the Jordan Valley is fact and not imagination. The revelation of the large amount of dew in the central Hula Valley is also new, and its extreme scarcity at the foot of the Jaulan to the east and the Galilee mountains to the west. Residents of Upper Galilee know that the air at Kefar Gil'adi and Aiyelet ha Shahar is very dry in summer nights. But in the northeastern part of the valley there are a large number of dewy nights, and not only in the vicinity of the swamps or in the irrigated areas. Again, at the foot of the Jaulan

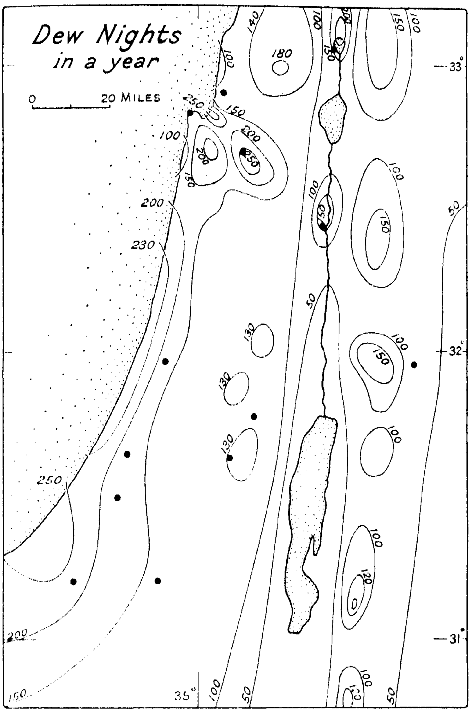

FIG. 1

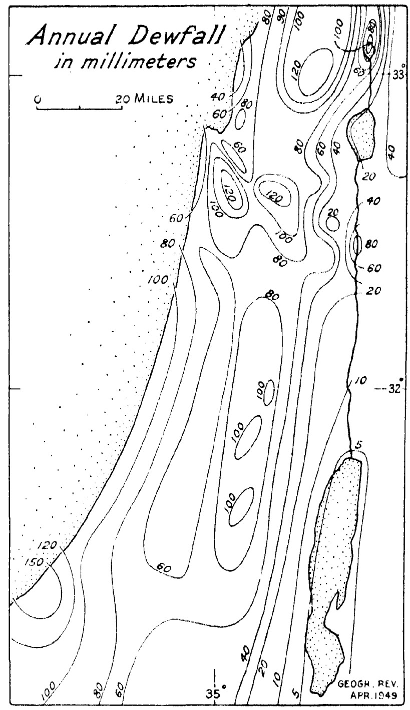

FIG. 2

Dew nights for the stations indicated on Figure 1—all in Palestine except Amman in Transjordan—are given in Table I. For rainfall distribution in Palestine see the author's map, 1941, Hebrew University Press, Jerusalem.

TABLE I—NUMBER OF DEW NIGHTS FOR SELECTED STATIONS

Station	Lat.N.	Long.E.	J	F	M	A	M	J	J	A	S	O	N	D	Year
Gevulot	31°13′	34°28′	17	13	15	18	17	22	22	22	22	18	18	17	216
Beth Eshel	31°15′	34°59′	9	11	13	12	11	13	10	12	11	5	14	14	135
Dorot	31°31′	34°39′	16	16	14	15	14	11	11	15	17	18	17	20	182
Negba	31°40′	34°41′	8	6	6	8	13	10	12	12	15	15	17	12	134
Sarafand	31°57′	34°51′	11	8	8	14	19	22	25	26	24	15	16	11	200
Kefar Masaryk	32°54′	35°07′	12	15	18	22	26	27	25	26	26	23	20	15	255
Nahalal	32°41′	35°11′	15	13	21	20	22	27	29	26	24	18	15	12	242
Carmel	32°48′	34°59′	6	4	12	15	17	25	25	25	21	9	11	6	176
Kefar Etsyon	31°39′	35°07′	12	7	11	13	7	12	14	12	15	13	8	7	131
Jerusalem	31°47′	35°12′	11	8	6	6	6	10	10	13	14	12	8	9	113
Tirat Tsevi	32°25′	35°31′	13	13	14	13	15	15	14	13	12	11	13	16	162
Dan	33°14′	35°39′	14	13	20	21	20	22	27	27	29	20	11	16	210
Amman	31°57′	35°57′	14	8	8	4	2	1	2	2	4	6	4	7	70

extreme night dryness prevails throughout the year. The paucity of dew on the mountains is an outstanding fact, on the east side of the Jordan as well as in western Palestine. We do not yet know the conditions in the high mountains deep in the Negeb. There is no doubt that in the eastern part toward the Araba depression the number of dewy nights decreases. The small amount of dew in the Judean desert and in the Dead Sea depression is merely being reaffirmed; it may be considered a result of the descending prevailing winds.

Two areas have some two hundred dewy nights in the year: the western coastal Negeb and the west-central part of the Valley of Jezreel. Two hundred dewy nights occur also in all the coastal plain from Gaza to Binyamina and in part of the Haifa-Acre valley. Parts of the coastal plain at the foot of Mt. Carmel (the whole of the coastal valley of Tantura and Atlit) and the entire coastal strip around Acre-Nahariya belong to the poorest dew-forming areas in the country. The summit of Carmel records two hundred dewy nights; the slopes, however, western or eastern, have not more than 150. About the same number—possibly as many as 180—occur in the high areas of Upper Galilee (around Jarmaq), but the other mountains have less. In Menara, for instance, which definitely has a rising temperature during the night but lies on a "col," there are no more than 140 dewy nights a year, and from this number must be deducted some 50 foggy nights. The mountains of Samaria and eastern Lower Galilee are poorer than the mountains of Judaea. At Kefar Etsyon and environs an average of 130 nights a year has been recorded over a period of four years, of which fog (here low clouds that creep over the ground from the west) accounts for no small part.

In the city of Jerusalem, which lies on the eastern slope of the mountains, western fog does not play any role during the summer. Heavy summer fogs occur in the valleys of Motsa and Qiryat 'Anavim. Poorest of all in dew are the eastern slopes of the mountains of western Palestine, which roll down to the Jordan and the Dead Sea. The area east of the divide is a partial or complete desert, which becomes progressively worse toward the east. The valley of Harod and the eastern and northern slopes of Mt. Gilboa, with the exception of places near springs, belong to this category. This was known thousands of years ago (compare the curse of David, II Samuel, i, 21).

The picture will not be complete if something is not said on the differentiation and classification of areas that have about the same number of dewy nights in the year. It would seem that in this respect there is no difference between the western Negeb and the Valley of Jezreel. This is not so. Hence we have classified the number of dewy nights according to the amount

of dew each night. The Negeb has a great advantage over all the other regions in the country because on the majority of dewy nights it receives "much" dew. At Gevulot, in the Negeb, about 26 kilometers from the sea, there are, out of 214 dewy nights a year, about 107 of "much" dew formation, 63 classified as "little," and 48 classified as "medium." In the strip of territory close to the sea dew formation is far greater. This statement is confirmed not only by the evidence of residents but also from the fields and crops in the vicinity of Khan Yunis.

To determine the total amount of dew formed on plants, one must multiply the amount formed on horizontal surfaces by a given factor. Experiments conducted at the Agricultural Experiment Station at Munich, Germany, showed that on potato plants the amount of dew formed was 7.07 times the amount formed on the horizontal surface taken up by the plant on the earth. On Egyptian beans a meter and a quarter in height the amount of dew was 6.61 times the amount formed on horizontal ground, on sugar beets 6.1 times, and on clover 2.5 times. It would therefore not be exaggerating to say that a multiplication of the amount of dew formed on horizontal ground by three or four would give the amount of dew formed on plants. If a night of large dew formation is regarded as equivalent to 0.3 millimeter and in certain cases to 0.5 millimeter, in 107 nights of large dew formation some 32–54 millimeters is formed on horizontal ground and about 100–150 millimeters on the total surfaces of the bodies concerned. There are also nights of smaller dew formation, in which at least 30–50 millimeters is formed. Hence the annual total of dew forming on plants may be not less than the total annual rainfall in the western Negeb (100–250 millimeters). Dew, furthermore, has the advantage of forming during the hot months, when the consumption of water is greatest. It should not be forgotten that, because of the great humidity of the air on dewy nights, there is almost no evaporation during at least 10–12 hours a day in summer, and about 14–15 hours in winter.

Throughout the country, aside from the Negeb, there is a clear annual march in the distribution of dewy nights; for during the rainy season there are rainy and clouded nights, so that the total of dewy nights is smaller than during the clear summer nights. In the Negeb, with its smaller rainfall and a large number of clear nights during the cold season, when the soil is damp from the rains, the annual march is not noticeable.

LESSONS FROM THE EXPERIENCE OF THE MAP INFORMATION SECTION, OSS*

LEONARD S. WILSON

EARLY in the war the procurement, evaluation, and distribution of maps for the research and operational branches of the Office of Strategic Services became urgent problems that no organization in Washington was prepared to solve. Because of the nature of modern warfare, nearly every military or war agency, such as the Combined Chiefs of Staff, the Joint Chiefs of Staff, and the Board of Economic Warfare, required identical map coverage. The Army Map Service and other operational supply agencies also required maps of the same areas. The situation was not peculiar to the United States; a competitive scramble for maps arose in London and Berlin[1] as well as in Washington.

In the United States and Britain individuals were at first permitted to borrow from established depositories. As a result, many of the most usable maps from the major collections were securely locked away in the file cabinets of individual workers. Other maps were shipped out of Washington to all parts of the United States, with little or no record of destination. Because of the conflicting demands, the custodians of the larger collections were forced to refuse the loan of maps to agencies that abused withdrawal privileges. In 1942 the Division of Maps of the Library of Congress and the State Department's Division of Geography and Cartography curbed the circulation of their holdings and the Army Map Service and the Hydrographic Office refused to lend maps except through official liaison channels.

The problems of map procurement were further aggravated because research workers, including geographers, had little knowledge of sources of supply or of the nature of the material available. Widespread ignorance about map intelligence produced an array of credulous requests that taxed the already overworked staffs of the older and more comprehensive map collections.[2]

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*The author is indebted to Major General William S. Donovan, Colonel Laurence Martin, and Mr. William Applebaum, for assistance in the organization of OSS map-information work and for the helpful suggestions and criticisms contributed to the present manuscript.

[1] Dr. Hans Meyer of the Reichsamt für Landesaufnahme in an unpublished manuscript characterized the German war effort as being "ruled by the law of the cartographic jungle."

[2] Among government agencies, only the Library of Congress, the Army Map Service, and the Department of State maintained comprehensive map collections of foreign lands. The only private sources were the American Geographical Society and the University of Chicago.

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The Map Information Section and Its Functions

In November, 1941, a Map Information Section was authorized within the Geography Division of OSS to serve the needs of the Research and Analysis Branch. By February, 1942, a small staff of geographers had been assembled, naïvely filled with enthusiasm for the task ahead. The Section was to be purely an information center, with no responsibility for the acquisition of maps, but as the scope of OSS operations broadened, the activities of the Map Information Section correspondingly expanded, to meet the needs of other agencies and to include procurement and distribution of maps and map intelligence. Effective procedures were finally developed. The function of each individual was studied and evaluated. Job descriptions were prepared in which work was outlined in such detail that they remained in use, with only minor modifications, until the demobilization of OSS.[3] Many members of the Section were at first skeptical concerning the "red tape," but eventually the competency of the methods was unreservedly accepted.

The acquisition of map information by OSS may be divided into three phases: (1) procurement of map information; (2) domestic procurement of maps; (3) foreign procurement of maps and map intelligence.

The Map Information Section confined its early activities to the function first laid out, the supplying of knowledge and services on request—the location of a specific map or place, the borrowing of a map from a library, or the photostating of a map to a given size.

Cordial relations and regularized procedures were established with the Library of Congress and the Army Map Service and proved mutually beneficial. However, the almost complete lack of cataloguing of governmental collections proved a handicap. The Library of Congress maintained an excellent catalogue of early American maps but had no catalogue of current foreign maps. The Department of State maintained a partial catalogue. The Army Map Service had a voluminous but inaccurate catalogue that had been compiled as a WPA project, and this was furnished to the Section by the Topographic Branch of G-2. A card file of the holdings of Clark University was also made available. It was manifestly impossible to assemble the staff necessary to catalogue the four million maps held by the Library of Congress or the more than one hundred thousand sheets in the collection of the Department of State. The search for catalogues was limited to existing lists of foreign map publications. Naturally, but unfortunately, in time of war these valuable publications of enemy map agencies are the

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[3] See, for example, L. S. Wilson: Library Filing, Classification, and Cataloging of Maps, with Special Reference to Wartime Experience, *Annals Assn of Amer. Geogrs.*, Vol. 38, 1948, pp. 6–37.

most difficult to obtain. Copies of catalogue volumes were borrowed from the Library of Congress, the Department of State, and the Army Map Service. These were photostated and held as a basic reference file. However, many of the catalogues were obsolete, none showed the holdings of the several collections, and none were of value in obtaining the special subject maps that were in greatest demand and shortest supply.

Microfilming of Map Catalogues and Maps

Before the outbreak of war the Division of Geography and Cartography of the Department of State had microfilmed the Research Catalogue of the American Geographical Society. In 1942, with the Society's permission, a duplicate copy was placed in the file of the Map Information Section of OSS. This acquisition led to a project to microfilm all usable maps housed in the major collections of the United States.

The microfilm project faced two important questions: How much could large maps be reduced photographically? And how could color be reproduced? After many experiments it was determined that maps no larger than a standard topographic sheet of the United States Geological Survey could be satisfactorily photographed in one piece; larger maps had to be photographed in sections. The practice of photographing the title or legend section first and the rest of the map in clockwise order was standardized. Each map was coded for location within a collection, reel number, and exposure number within the reel. The multiple exposures necessary for a large wall map were numbered as to position within the whole map. The catalogue numbers used in the collection that owned the map were reproduced on the individual exposures in large type.

The second problem, that of color, was never completely solved. In cooperation with the Army Map Service and the Special Photography Section of the Presentation Branch of OSS, experiments were made with both Agfa-color and Kodachrome. Trials made with 35-millimeter and 3¼ x 4¼-inch film yielded unsatisfactory results. The color reproduced satisfactorily enough, but place names became illegible. As a result, color photography was abandoned, and regular panchromatic microfilm stock was used to copy all desired maps. The process, however, was both expensive and slow. A faster method of supplying map information was needed. A battery of library microfilm readers was purchased, and also a larger viewer, capable of projecting a film onto a clear-glass table top so that a map at any desired scale could be drafted from the film.[4]

[4] Although the distortion inherent in photographic lenses was present in the microfilm copy, it

Use of the film collection was extended to other agencies, and the films served many purposes. Research workers, however, were reluctant to use them, both because of the resulting eyestrain and because of the inconvenience of locating a specific exposure in a reel of about 850 separate maps. To overcome this inconvenience, material within each reel was carefully organized. The maps to be microfilmed were arranged in an orderly sequence by (1) area, (2) subject, and (3) date of publication, the most recent first. In general, the following arrangement by areas and subjects proved satisfactory, though maps in periodicals and books do not lend themselves to such treatment.

Arrangement by Areas

World; Hemisphere; Continent; Part of a continent; Country; Part of a country; Major political subdivisions; Minor political subdivisions; City; Part of a city.

Arrangement by Subject

Outline and base maps; General maps; Physical maps (Relief, topographic or physiographic; Hydrographic, oceanographic; Geologic; Soils; Climate; Vegetation); Political and administrative maps; Economic maps (General; Mineral resources and mining; Forest resources, lumbering, hunting; Sea resources, fishing; Agricultural production; Industrial production; Trade, transportation, communication); Demographic maps (General; Population; Ethnographic; Linguistic; Religions); Historical maps.

The reels were filed by regions. The contents of each reel were marked on the reel box according to the above plan, also the source, reel number, date of preparation, region, and number of maps in the reel and in the total sequence of the project. Rapid scanning was facilitated by the insertion of colored film strips at the beginning of a new subject; for example, as the film passed through the microfilm reader, a red flash would indicate the beginning of a series of maps dealing with economic distributions, a green flash the beginning of a series of city plans.

The collections maintained by the Library of Congress, the Department of State, and the American Geographical Society were examined, evaluated, and microfilmed by the Map Information Section. The collections at the University of Michigan, the University of Chicago, and Harvard University were microfilmed by contract. The Royal Geographical Society[5] and the British Directorate of Military Survey, Geographical Section of the General Staff, agreed to make their collections available for microfilming, but these

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was no greater than similar distortion in any photocopy material. Since the use of the machine was limited to cartographic work and the rules in force with regard to scale required more than a 50 per cent reduction in final scale as opposed to drafting scale, the distortion could be overlooked.

[5] With the cooperation of the American Geographical Society, a copy of the film of the Society's map collection was presented to the Royal Geographical Society in July, 1944.

projects did not materialize (see below). Through exchange, a complete series of film prints of the Army Map Service library collection was obtained.

Domestic Procurement of Maps: OSS Map Collection

Procurement and supply, not originally conceived as functions of the Section, were made necessary by the demand and by the tasks assigned the Section in connection with the Roosevelt-Churchill conferences.

Procurement was at first limited to borrowing material. Excellent co-operation was received from the Division of Maps of the Library of Congress, whose overworked staff had constant demands made upon it for the loan of material, some of it irreplaceable atlases and maps. Later, the increasing volume of business and the problem of duplicate requests combined to force the Section to establish its own map collection.

In its infancy the collection consisted of photographic and photostatic negatives of maps belonging to the Library of Congress, the Department of State, and the Army Map Service. Requests for assistance in obtaining and evaluating maps and for reproduction of maps recommended for inclusion in reports or for operational uses were filled from this collection. Requests that could not be filled were referred to the Cartographic Section of OSS.

A nation-wide radio appeal by Major General William J. Donovan, Director of Strategic Services, brought in a large number of maps and considerable travel information. The OSS obtained the German Library of Information, the French Library of Information, and the contents of the offices of the German and Italian Chambers of Commerce. Maps and atlases were purchased from bookdealers specializing in foreign publications. A concerted effort was made to obtain all possible material available through domestic sources.

Although direct foreign procurement could not be undertaken at this time, substantial amounts of material were received from the British Inter-Services Topographic Department and the Royal Naval Intelligence Division 5, respectively publishers of the ISIS reports and the Geographical Handbooks. Colonel C. Bassett, R.M., and Admiral J. H. Godfrey, directors respectively of ISTD and Naval Intelligence, R.N., assisted in establishing map exchanges between the Allied planning staffs; subsequently a close working alliance was maintained through the London Map Division of OSS.

The resources of all governmental departments were explored. One of the largest collections of Japanese topographic maps on the scale of 1 : 50,000 was uncovered in a Department of Agriculture vault, where the original procurer, an expert on chestnut blight, had carefully locked them on De-

cember 7, 1941, because he did not want the responsibility of caring for them! The Department of Agriculture yielded more than 1200 sheets at a time when, after six months of war, the combined holdings of the Army Map Service and the Hydrographic Office totaled less than half this number. The Division of Maps and Charts of the National Archives produced nearly a hundred city plans that had been turned over to it by the Department of State in 1941, among them modern plans of most of the cities of sufficient importance to support a diplomatic office of the United States Foreign Service.

The largest supply of maps was obtained through the cooperation of the Army Map Service. Early in the war representatives of the Corps of Engineers, United States Army, met with representatives of the British Directorate of Military Survey, GSGS, and divided the world into two spheres of mapping responsibility. The details of this Anglo-American agreement have not been completely divulged. In broadest terms, the British were to assume responsibility for the production of all tactical, operational, and strategic maps of areas where the Directorate of Military Survey and its affiliated mapping arms were already in operation. The Americans were to be responsible for the remaining areas of the world. The British furnished the Army Map Service with color pulls of all their existing production and a limited supply of their maps. The Army Map Service, in turn, delivered two copies of each British original to the Map Information Section of OSS and also contributed an unlimited supply of reprinted British compilations and such maps as were constructed by the United States Army.

Thus the large-scale map requirements of OSS were satisfied, though the timing problem continued to plague the Section. The needs of the high-level planning agencies, particularly the Joint Chiefs of Staff, had to be anticipated and fulfilled before the operational orders under which the Army Map Service scheduled its production were written. Consequently, most requests handled by the Section during 1942–1944 could not be filled through normal military sources.

A regular exchange with the Army Map Service continued until the end of the war, and similar arrangements existed with the Aeronautical Chart Service, the Army Air Forces, and the Hydrographic Office of the United States Navy. By the end of 1943 nearly half a million sheets were housed in the collection, all of which had been obtained from the sources mentioned.

Foreign Procurement of Maps and Map Intelligence

With the expansion of OSS operations in 1943, Map Division offices were set up in Algeria, Egypt, India, and China. These functioned until the

end of hostilities afforded opportunities for procurement of maps directly from seldom-visited Near and Far Eastern cartographic agencies. Outstanding were a motor-truck expedition from Cairo to Baghdad that resulted in the acquisition of hundreds of maps produced by the governments of Syria, Palestine, Iran, and Iraq; negotiations for the purchase and exchange of maps produced by all branches of the Chinese government; investigation and procurement of captured stocks of Japanese maps covering Southeast Asia (on this expedition the Map Division suffered its only war casualty, Mr. J. H. Coolidge, inflicted by revolutionaries in Indochina after the termination of hostilities with Japan). A two-month reconnaissance of Africa from Cape Town to Cairo, resulted in a better understanding of the parts played by the British and Belgian Colonial Survey Departments.

By early 1944 there were large requirements of men and supplies for OSS activities in the European theater of operations. Together with members of the operational groups and other research and analysis teams, Map Division personnel were assigned to London. Maps and models[6] were constructed, large quantities of maps were procured, and plans were made.

From the outset the most important duty of the office was to coordinate OSS map work with that of its British counterpart. Negotiations with the British War Office were concluded most satisfactorily on June 20, 1944, and a mutually beneficial exchange was agreed on, excluding various top-secret and secret maps. The services and personnel of each organization were placed at the disposal of the other. The agreement concluded with Brigadier M. Hotine and Colonel C. J. Willis, respectively Director and Deputy Director of Military Survey, also stipulated that each agency should produce new maps to the specifications desired by the other. The OSS map unit was given official status in the European theater of operations, and necessary equipment and supplies became available from the British to be charged against the lend-lease agreement between the United States and Great Britain. Under this arrangement thousands of sheets were made available that had not been obtained by the Army Map Service under the earlier British-American agreement.

Procurement and exchange agreements with other British agencies were also implemented. A formal contract with Dr. Arnold Toynbee, Chief of the Foreign Office Research Department, made available political maps

[6] Through the courtesy of the Ministry of Home Defense a completely staffed and equipped model shop at Leamington Spa was lent by the British to the London Map Division. It produced large-scale operational models for guerrilla operations in France and Germany. The techniques employed by this unit differed materially from those developed by American model makers. See H. P. Reed: The Development of the Terrain Model in the War, *Geogr. Rev.*, Vol. 36, 1946, pp. 632–652.

prepared by the Foreign Office. At Oxford University the British Inter-Services Topographic Department, which had been in operation since the ill-fated Norwegian expedition, agreed to supply to the London OSS office a limited number of copies of all maps produced by them.[7] Similar agreements were made with the Ministry of Economic Warfare, the Political Intelligence Division of the Foreign Office, and Naval Intelligence Division 5, Royal Navy.

Several governments-in-exile were tapped as sources of maps and map information. By offering cartographic assistance in exchange, the OSS London Map Division office concluded a series of working agreements with the Belgian, Netherlands, Luxembourg, and Polish governments-in-exile. Geographic data received from the underground agents of these governments were delivered to the Cartography Section of the Map Division in London and made into maps. Multiple copies were given to the governmental sources, and in exchange additional compilation data were obtained. These agreements were also intended as a good-will investment against a later day when OSS representatives would need the assistance of the foreign governments to further field operations, and perhaps also to continue map exchanges in peacetime.

A partial examination was made of the public and private map-producing agencies in England and Scotland, and useful items were purchased. The Royal Geographical Society was a constant source of information and maps, and, as has been stated, plans were made for the microfilming of the Society's collection and the library collection of the Directorate of Military Survey. Unfortunately, the camera was lost in shipment. It eventually appeared on Omaha Beach shortly after the invasion of France.

On the eve of D-day the OSS London Map Division was intensively occupied in the procurement, evaluation, and construction of vast quantities of maps and models for all phases of OSS activity. Simultaneously, agreements were made with the Military Intelligence Reporting Section SHAEF for the routing of captured maps to the OSS London Map Division before circulation to other interested agencies and with the Directorate of Military Survey for the exchange of information regarding the activities of each OSS map-intelligence team dispatched to the continent. It was further agreed between the Directorate of Military Survey and the OSS London Map Division that, whenever possible, they would procure for mutual and unrestricted exchange three additional copies of each captured map.

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[7] For further details of British cartographic and map work during 1944 see L. S. Wilson: Some Observations on Wartime Geography in England, *Geogr. Rev.*, Vol. 36, 1946, pp. 597–612.

Eventually map offices were opened at OSS headquarters in Paris, Vienna, Bari, Bern, and Biebrich in Europe and in Cairo, Algiers, Kandy, New Delhi, and Kunming in other theaters. From each headquarters, field teams of trained geographers searched for maps, interviewed foreign geographers, examined map-making activities and methods, and passed back to Washington a constant flow of intelligence and captured maps and models.[8] Much of the intelligence obtained was examined critically on the spot, and if it proved to be of value to current operations it was referred to field detachments of the Directorate of Military Survey. Materials of no immediate operational concern, but of value to long-range planners, were shipped directly to the Washington office.[9] Interviews with French and German geographers and map makers were of considerable value to immediate military operations. OSS map teams arrived at the Justus Perthes plant in Gotha while the city was still partly occupied by German forces. The plant was found in good condition; the working staff was on the premises, and the map stocks were intact. Copies of all publications and maps, to the amount of nine tons, were removed, and interviews were conducted with officials.

The same group made detailed examinations of the geographic holdings of the German Foreign Office in Berlin, Mar-Geo, Mil-Geo, the Abteilung für Kriegskarten und Vermessungswesen im Generalstab des Heeres, and the Reichsamt für Landesaufnahme. The map collection of the Prussian State Library, discovered in a salt mine, was thoroughly utilized. Dr. Otto Schulz-Kampfhenkel was interrogated, and the contribution made by the Forschungsstaffel z.b.V. to the German military operations in Egypt and on the eastern front became known, also its relationships to the Oberkommando der Wehrmacht, the SS, the Reichsforschungsrat, and other military and civilian official German agencies. The advanced mapping techniques and the capacities of the personnel of the unit known as the Sonderkommando Dora Amt, Ausland Abwehr, were studied, and the data, later published by the United States Department of State, were delivered to Allied military authority. Special strategic maps, such as the Hermann Goering Atlas and the Atlas de l'Espagne, were obtained through the activities of the professional geographers.[10]

[8] See, for example, T. R. Smith and L. D. Black: German Geography: War Work and Present Status, *Geogr. Rev.*, Vol. 36, 1946, pp. 398–408.

[9] See, for example, Eric Fischer: German Geographical Literature 1940–1945, *Geogr. Rev.*, Vol. 36, 1946, pp. 92–100.

[10] L. S. Wilson: A Functional Atlas of Wartime (*Goering's Atlas*), *Annals Assn. of Amer. Geogrs.*, Vol. 37, 1947, pp. 182–184; *idem:* A Geographical Intelligence Document (*Atlas de l'Espagne*), *ibid.*, Vol. 38, 1948, pp. 111–112.

Similar activities were carried out in France with friendly cooperation.[11] Agreements were negotiated between the Paris office of the OSS Map Division and the Institut Géographique National and the French Hydrographic Service for the exchange of materials published by each agency since 1939. A difficult map-procurement assignment also was successful in spy-ridden Switzerland.

In each of these instances, because of the wide latitude and authority inherent in the over-all concept of intelligence possessed by OSS, teams of geographers were present at, or in the vicinity of, major centers of geographic work at the time of capture, with fortunate results, as regards both the immediate evaluation of map-intelligence data and the acquisition of strategic material of long-range interest.

The establishment of a coordinating map unit in OSS, disassociated from any of the operational arms of government, made possible for the first time the achievement of unified and impartial attention to topographic, hydrographic, and specialty maps and map intelligence.

Map Evaluation

Map evaluation was by far the most difficult undertaking attempted by the Section. The overwhelming majority of American geographers had had little training in the use of maps, particularly foreign maps, and with few exceptions staff members had literally "to start from scratch."

A map is the work of a map maker; to a varying degree it falls short of being an objective, factual, scientific document and becomes the product of personal opinion and interpretation that may be at variance with reality.[12] In making evaluations and analyses numerous criteria were employed by the Section to establish the reliability, authenticity, and derivation of large-scale operational maps and small-scale planning maps. In this paper the various criteria of evaluation can only be mentioned. Basically, three distinct phases were used: (1) publishing authority; (2) compilation methods and techniques; and (3) purposes underlying construction.

Every map agency has its own cartographic standards, which largely reflect the professional qualifications of its personnel. By investigating the professional personnel standards of agencies on the basis of prewar descrip-

[11] F. W. Foster: Comments on French Cartographic Agencies during the War, *Annals Assn. of Amer. Geogrs.*, Vol. 36, 1946, p. 89. Abstract of a paper read at the Knoxville meetings, December, 1945.

[12] J. K. Wright: Map Makers Are Human: Comments on the Subjective in Maps, *Geogr. Rev.*, Vol. 32, 1942, pp. 527–544; and Max Eckert-Greifendorff: Kartographie Ihre Aufgaben und Bedeutung für die Kultur der Gegenwart, Berlin, 1939, especially Chapter 5 (pp. 322–425), "Die Karte in Politik und Erziehung."

tions of the requirements and qualifications for cartographic employment, it became possible to evaluate the work of the agencies. In this first phase of study, a card file was started showing the education, professional publications, professional memberships, field experience, and other recognitions of attainment of each responsible official.

Construction practices reflect the professional training and capacities of the employees of an organization still more accurately. Familiarity resulting from daily work with maps enabled professional members of the OSS Map Information Section to identify publications of Allied and enemy map agencies through the inks, types, and designs used in map making. As skill increased, it even became possible to approximate the year of publication and, in many cases, to identify source materials.

Evaluation of construction techniques was largely confined to positively identifiable features. Reduction factors introduced into maps at the time of plate making were an important indication of compilation standards. Diagrammatic presentation of information or insufficient detail in physical and cultural features might mean overreduction or the use of poor and inadequate compilation material.

In recent years some leading map agencies have included a relative-reliability diagram to inform the user of the cartographic controls used in the compilation of a sheet,[13] in other words to indicate its accuracy. Other agencies have devised a reliability code. Such codes are helpful but must be critically evaluated. Reliable map makers have shown a growing willingness to include map bibliographies on their sheets.

Most wartime cartography was restricted to one of three types: operational, strategic, or propaganda. Each was the responsibility of a different government agency.

Operational or tactical maps were produced mainly by the army cartographic agencies of the various nations. Examination of a limited number of sheets in a set was sufficient for evaluation of the entire set. Strategic maps required more thorough investigation. These maps were produced by a group of intelligence departments, and the underlying purpose of each had to be examined. They could be assumed to be as reliable as the personnel and compilation methods. Propaganda and public-information maps presented a maze of material, some of it so obviously incorrect that it could be immediately discarded. Each nation maintained an information agency, and

[13] The relative-reliability diagram was standardized by the American Geographical Society on its Map of Hispanic America on the scale of 1 : 1,000,000. The idea was derived from a map of South Peru and North Bolivia accompanying an article "The Land of the Incas" by Sir Clements R. Markham, *Geogr. Journ.*, Vol. 36, 1910, pp. 381–398.

its endless activity included a varying amount of cartographic work, which was consciously or unconsciously biased.

By the means and methods described above it was possible to recommend maps for specific purposes, and to prepare special map-evaluation studies. Map-coverage reports were integral chapters of every Joint Army and Navy Intelligence Study and were included in numerous OSS research and analysis reports. Evaluation studies were produced for the White House, the Department of State, and the British Prime Minister. After the termination of hostilities, additional papers concerned with political affairs were prepared and the work of JANIS continued. Special map evaluations were prepared for inclusion in a number of reports for United States officials and for circulation among governmental map organizations.[14] To cover this subject fully would require another paper.

Results and General Conclusions

The value of the four years' work done by the OSS Map Information Section can be judged by its results and by the reaction of professional geography to the aims and methods of investigation. The quantitative results include: (1) response to nearly a million requests for map information; (2) enlargement of the map resources at the disposal of governmental agencies by more than two million sheets; (3) formulation and preparation of map-intelligence reports for all branches of the federal government; (4) establishment of the working procedures and standards of map investigation now used in governmental agencies; (5) initiation of a union catalogue of maps through the microfilm files now in a governmental depository; (6) establishment of the first central map information service in the federal government, now disbanded.

Today, as in 1941, there is no central organization in Washington responsible for handling requests for assistance in the solution of map problems. Because of the rules and regulations laid down by the Bureau of the Budget, each departmental map unit caters to the exclusive needs of its parent governmental division. As a result, wide gaps appear in the structure of knowledge about foreign maps, and these widen as each department becomes more self-centered in its work program. It is to be hoped that the Hoover Commission for Reorganization of the Executive Branch of the Federal

[14] L. H. Dykes: Critique of British, Polish, American, and Soviet Maps of Polish-Russian Border Areas, R&A No. 2945, Interim Research and Intelligence Service, Research and Analysis Branch, Department of State, Washington, D. C., Oct. 23, 1945; also "Map Supplements for the American Draft Treaties with Austria, Hungary, Italy and Romania," Department of State, Washington, D. C., January, 1946.

Government will recognize the dependence of all nonprofessionals upon a centralized unit responsible for the evaluation of required maps, coordination of a foreign procurement program, and the establishment of a federal union map catalogue.

Recent comments indicate that there is doubt in the minds of many geographers concerning the peacetime value of research and experience gained under the pressure of war. Undoubtedly much research conducted by governmental agencies was unique and limited in its applicability, but this was not true of research conducted in map information. The type of investigation typical of the OSS program dealt with every phase of geography as outlined in Sauer's "Morphology of Landscape." It was not confined to "military purposes" in any strict interpretation of the term, and in actuality could not have been so interpreted under the directives which established the OSS or under the administration of its senior officials. As Hartshorne has said, "[The] distinction is not merely in the maps themselves, but rather in the use of the maps in the study—the true geographer cannot help but study the problem in terms of maps."[15]

Although it is too early to evaluate the long-range, professional results of war experience, some trends can be identified. Ackerman has called attention to the inadequate training in systematic geography and the paucity of usable information in the literature of the subject.[16] His remarks were directed to human geography, but they are equally applicable to map information. OSS experience revealed that American geography has been woefully weak in systematic map training and that the task of supplying reliable maps could be accomplished only through the development of new or improved methods of map evaluation. Whether the interest in maps and map information aroused by the stimulus of war will be retained sufficiently to place map training in a sound professional and curricular position within the realm of geographic philosophy and research remains to be seen.

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[15] Richard Hartshorne: The Nature of Geography, *Annals Assn. of Amer. Geogrs.*, Vol. 29, 1939, pp. 171–658; reference on p. 424.

[16] E. A. Ackerman: Geographic Training, Wartime Research, and Immediate Professional Objectives, *Annals Assn. of Amer. Geogrs.*, Vol. 35, 1945, pp. 121–143; reference on pp. 128–129.

ACCLIMATIZATION IN NEW GUINEA

ROBERT G. BOWMAN

THE investigation of high-altitude environmental influences so ably initiated and vigorously urged by Dr. Carlos Monge in his recent book "Acclimatization in the Andes"[1] should wake distant echoes. In New Guinea, for instance, the administration might well ponder the effective Inca state policy for the conservation of high-altitude man as Dr. Monge sets it forth. There is a real need for study of "altitudinal conditioning" and native economy in the mountainous interior of the world's second-largest island.

New Guinea now faces an acute labor shortage in its coastal lowlands, which contain almost all the small white population of the huge island (±4500) and the few scattered commercial enterprises. Australian anthropologists are currently urging that the native villages in these lowlands, small and widely dispersed, are already overtaxed by the legitimate (not to mention illegitimate) recruitment of labor for plantation and mining enterprises, with its disruptive and ultimately suicidal effects on native food supply, social life, and population replacement. At the same time, interior valleys in the eastern part of the island, at altitudes within, or at about, the lower limits prescribed by Dr. Monge for "high-altitude man" (2000–5000 meters), contain large concentrations of natives engaged in primitive subsistence farming of the "shifting cultivation" type. The density of population in parts of these valleys reaches 100 to the square mile. More than 200,000 natives are estimated to live in about a dozen valleys between the Kratke and Mt. Hagen ranges, an east-west distance of no more than 200 miles. The floors and cultivated slopes of these well-populated valleys lie at elevations between 3000 and 8000 feet. Considerable population pressure is already evident in the undesirably brief cycle of field rotation, in the frequent re-use of grassland difficult to clear with native tools and techniques, and in the lack of suitable and sufficient wood for fuel and house construction within handy reach. The natives are considered by the government to be unsuited for labor on the hot, humid, and generally unhealthful lowlands, but they also, and for reasons not clearly understood, have so far failed to colonize several seemingly attractive valleys between Mt. Hagen and the Dutch border, a short distance to the west of their present areas of concentration and at but slightly higher altitudes (8000 to 10,000 feet).

What is the significance of the suggested "ceiling" and "floor" to relatively dense native concentrations? Are the upper and lower limits set in general or exclusively by the quality of the land or by the cultural level or physiological characteristics of its natives? Can anything further be done, through internal resettlement or other innovations, to ease the labor shortage in the lowlands or the population pressure in parts of the highlands? Are there any lessons to be learned here that may ultimately have wider application within New Guinea, in other parts of Melanesia, or in similar environments elsewhere in the world?

These are questions that can hardly be answered at present; for interior New Guinea,

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[1] Dr. Monge's book, published in 1948 by The Johns Hopkins Press, is being distributed by the Society to its Fellows; see p. 318.

➤ ROBERT BOWMAN, associate professor of geography at The State University of Iowa, contributed "Army Farms and Agricultural Development in the Southwest Pacific" to the July, 1946, number of the *Geographical Review*.

despite wartime focus of interest on the island, remains imperfectly explored and practically without scientific inventory. Such knowledge as we have, however, enables us to point out certain suggestive features of local physical and cultural geography the further study of which, together with laboratory and other approaches to the problem of altitudinal conditioning, would seem desirable in connection with the safeguarding and promoting of native welfare along with greater commercial development of New Guinea's known and varied resources. The following remarks, based on incomplete empirical observations and source materials,[2] are no more than a preliminary scouting of certain aspects of the matter.

In my view the present administration[3] of New Guinea is justified in restricting further recruitment of native labor in most parts of the lowlands. Scarcely anywhere in these lowlands has there been indication of significant population increase among the natives in recent decades, and in some areas, such as the Markham valley, there has been a conspicuous decrease. The reasons for decline appear complex but probably include the introduction and spread of various diseases, such as measles, chickenpox, smallpox, dysentery and other enteric diseases, venereal infections, and pulmonary infections, against which the natives have acquired little or no immunity; intertribal warfare; the clearing and burning of forest land for garden plots that will be quickly replaced by thick, coarse "mats" of *kunai* and kangaroo grasses, which resist native efforts to cultivate the soil further, or will revert to a forest climax vegetation; and overdrafts on village labor for commercial plantations and mines, with the attendant drain on native food supply and interference with normal social life and village organization. Some government officials would add the missionizing of coastal natives; others, with whom I am inclined to agree, contend that there is no clear evidence of a cause-effect relationship between the spread of Christianity and population decrease in New Guinea.

There is also good reason to believe that the government is justified in prohibiting recruitment of native labor from the interior highlands for work in the coastal lowlands. The natives living above 5000 feet have no immunity to malaria, which apparently is endemic in most, if not all, parts of the island below that altitude. Nor is that the only risk. As recently as 1944 some of the natives of the interior were exposed for the first time to bacillary dysentery, and since then thousands have died from this infection, which is fairly common in the lowlands. And undoubtedly there are other diseases that would swiftly become epidemic.

Of still greater importance are the long-range effects of the deleterious lowland climate

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[2] Field observations in 1944 (Mar.–Aug.); interviews with Australian military and civil administrators, missionaries, agriculturists, anthropologists, and ex-residents; interviews with American medical officers; and a preliminary survey of available literature. See also the review of "Prospects for Settlement in Northeastern New Guinea" elsewhere in this issue of the *Geographical Review*.

[3] This article is concerned with the eastern or "Australian" half of the island, more particularly with Northeastern New Guinea. The designation "Territory of New Guinea" applies to the Trusteeship held by Australia over "that portion of the islands of New Guinea and the groups of islands administered therewith under the mandate dated 17 December 1920, conferred upon His Britannic Majesty and exercised by the Government of Australia" (United Nations Trusteeship Agreement, Dec. 13, 1946); that is, Northeastern New Guinea, the Bismarck Archipelago, and the northern islands of the Solomons. Following the war the Territory of New Guinea was joined in a provisional administration with Papua. A bill before the Australian Parliament provides for administrative union of Papua and New Guinea with a single administrative head and one legislative body (*Australian News Summary*, Feb. 8, 1949).

on what is now a relatively healthy, sturdy, energetic, and fertile highland stock of mixed Papuan-Melanesian and Caucasian ingredients. Is the climatic contrast between elevations of 4000–7000 feet and less than 1000 feet sufficient in itself to impair the health, vigor, and reproductive capacity of these natives? If so, is it a temperature, humidity, or atmospheric-pressure effect, or a combination of the three? Could it be combated successfully by changes in diet, adjustment of work schedules, gradual transfer through a succession of "staging areas" at progressively lower altitudes, or some other measure that might favor acclimatization in lower levels? Simultaneously to relieve the lowland labor shortage and the highland population pressure would indeed be an achievement, but we cannot afford to be optimistic about such possibilities; for we know neither the nature and degree of the risks nor the means for their removal. But at least a beginning can be made in the form of comprehensive empirical studies and controlled experiments; indeed, it will sooner or later *have* to be made if medical science does for highland-population growth rates what it has done in, say, Central America.

The question whether or not there is a physical "ceiling" on permanent habitation by these natives in the highlands of eastern New Guinea is no less complex and difficult to answer. Our present incomplete knowledge would seem to indicate that the large concentrations do not extend much above 7000 feet, though some natives apparently maintain permanent, or at least semipermanent, dwellings in a few valleys at elevations up to 8500 feet and possibly higher. We need more information on the extreme upper limits of permanent habitation. It would help if we had sufficient data to draw isopleths of population-density variation with altitude. There *seems* to be a rapid decrease beginning somewhere between 6000 and 7000 feet. Has that always been the case, and if so, why? The occurrence of fairly large tracts of grassland on some of the mountain slopes up to 10,000 feet and in places even higher, and also on certain valley floors between 8000 and 10,000 feet, suggests extensive burning and/or clearing of forest; for the areas seem to have a "forest" climate with abundant rainfall and cool but not severely cold temperatures, and patches of forest are found locally. If these grasslands were culturally induced, were the natives who brought about the transformation ever truly acclimatized at these upper levels? And why were they abandoned? Was it a brief, ill-advised experiment, an effort to escape the limitations of a valley-floor terrain and increasing pressure on food supply by an organized sweep up the mountain slopes? If that is what happened, was it rarefied atmosphere, excessive humidity, or chilling temperatures and concomitant sickness that drove them back? Or was it perhaps soil exhaustion, the relentless invasion of their clearings by grass, crop disease or blight, or some other natural or cultural enemy? Perhaps all we can be certain about at present is that the grass is there where it would seem that forest ought to be and for the most part the people are not, at least over wide expanses of mountain range and in certain valleys above 8000 feet.

A possible explanation of this present restriction of native farming to levels below 8000 feet or lower was suggested to me in 1944 by Mr. James Lindsay Taylor, one of the ranking government officials in New Guinea, who discovered these well-populated highland valleys in the interior of eastern New Guinea in 1937 and whose later patrols revealed the existence of the seemingly attractive, unpopulated valleys west of Mt. Hagen almost to the Dutch border. Taylor reasons that the upper limits of native farming are set by the limits to which the sweet potato—the basic staple—can be cultivated, which he thinks are here about 8000

feet for the hardier varieties. He admits that this is more opinion than knowledge and cites unoccupied valleys below this level. Moreover, it fails to explain the grasslands at higher levels; and it raises the question whether or not a satisfactory food substitute for the sweet potato could be introduced—Andean potato? pandanus? small grains?—that would permit extension of native agriculture to higher elevations, or whether these high grasslands might be used for native livestock ranching, with interchange of food products between an upper ranch zone and a lower farm zone. The natives are already experienced pig raisers, but meat is generally in short supply in all their villages.

We must not overlook the possibility that relatively low temperatures together with moderate to high humidity will have a restrictive effect, even if good land is available and a crop complex or ranch staple can be found on which to base an upward migration. During my visits to Garoka, Bena Bena, Kerowagi, Chimbu, and Mt. Hagen in 1944, all well-populated localities between 5000 and 6000 feet above sea level, I was impressed by the extent to which the natives appeared to suffer from the cold of early morning and late evening, when chill mists often invade the valleys and enshroud the adjacent mountain slopes. With "clothing" limited to a few body ornaments, they shiver and hug themselves and try to keep on the move in an effort to increase circulation. At night they generally remain close to the fires kept burning in pits in the floors of their low, well-thatched, and well-chinked dwellings.

Is protective clothing the answer? That has already been tried in a few places and has met with little success. Usually but one change of clothing, if any, is provided, and native habits and native "laundries" being what they are, the garments quickly become such superior breeding places for vermin that even the not too fussy natives discard them at the first opportunity in favor of the traditional skin application of rancid pig grease. In the interest of health and hygiene as well as for economy, the government has refrained from urging clothing upon the natives, except those employed at indoor work in government buildings and the native constabulary, who are supplied with uniforms.

As far as the need for additional cropland is concerned, there is no emergency at present, but if the government is successful in its efforts to improve health standards through expansion of hospital facilities, training of nurses and doctors, education in hygiene, and the like, we may look for substantial population increases in the highlands, where there is already evidence of high fertility and substantial pressure on food supply. Can science and education effect improvements in food production there so that it will keep pace with geometric increases in population *without* adding to the area of cultivated land? Unless that is a reasonable certainty—and there is some basis for doubt—then it would seem wise to consider carefully and soon the prospects for expansion of native farming into the remaining unused or little-used valleys at higher, and perhaps lower, elevations. Also, there would seem to be need for an educational and economic policy that will encourage greater variety and abundance of material wants and goods and discourage large families, at least in the more populous highland valleys. Otherwise we may have in the making here another Puerto Rico, with desperate poverty and starvation the ultimate reward for "good" government, Christianity, and modern medicine. It is neither too early nor too late to begin studies and initiate steps to prevent such a crisis in New Guinea.

THE AMERICAN GEOGRAPHICAL SOCIETY

The January Lecture and the Glaciological Conference

On January 18 and 19, 1949, the American Geographical Society, the Arctic Institute of North America, and the American Alpine Club jointly sponsored a series of meetings to discuss various aspects of glaciology. On the evening of January 18, Mr. Walter A. Wood presented his film "Snow Cornice" in the auditorium of the Engineering Societies Building, 29 West 39th Street, at the regular meeting of the Society, Mr. Woodfin L. Butte in the chair. Mr. Wood was introduced by Dr. Laurence M. Gould, President of Carleton College. The film dealt with the Arctic Institute's expedition in 1948 to establish a research station and conduct glaciological studies on the névé of Seward Glacier in the St. Elias Mountains of Alaska and the Yukon Territory.

On the afternoon of January 19 a conference to discuss various aspects of glaciological research was held in the office of the Arctic Institute in the Society's building. Twenty-two persons were present, representing the Society, the Arctic Institute, the Department of Geology at Columbia University, the United States Geological Survey, the Office of Naval Research, the Bureau of Mineral Research at Rutgers University, the Departments of Geology at Tufts and Lafayette Colleges, and the American Alpine Club.

Dr. Richard U. Light, President of the Society, welcomed those present and then turned the meeting over to Mr. William O. Field, Jr., who acted as chairman. Three prepared statements were presented. Mr. P. D. Baird, director of the Montreal Office of the Arctic Institute and secretary of the International Commission of Snow and Ice, gave a "Report on the Oslo Meeting in 1948." Dr. Henri Bader of the Bureau of Mineral Research at Rutgers and formerly assistant director of the Weissfluhjoch Snow and Avalanche Research Station, spoke on "Current Trends in Glaciology." Dr. Walter H. Bucher, professor of geology at Columbia University and president of the American Geophysical Union, discussed "Structural Features of Ice Bodies." Brief statements were then made describing four glacier-study projects under way or in the planning stage. Mr. Wood told of the glaciological program of Project "Snow Cornice," supplementing the remarks made in his lecture on the preceding evening. Mr. Baird outlined the plans for a cooperative scientific expedition to east-central Baffin Island in 1950, a feature of which will be the study of its interesting icecap, unique in that it occupies relatively low ground of little relief. Mr. Field described the Society's Glacier Research Project, with its studies of the Juneau ice field in Alaska and the glaciers of Patagonia. (A detailed report on this will be published in the July number of the *Geographical Review*.) He also told of the function of the Committee on Glaciers of the Section of Hydrology of the American Geophysical Union and its long-term program to promote the study of various aspects of glaciology.

The second half of the conference was devoted to a round-table discussion, in which most of those present took part. A great variety of matters were taken up, which may be divided into three general categories: theoretical considerations, specific suggestions in regard to glaciological research in general, and comments on the ice-field studies in Alaska and the Yukon that were begun in 1948 and are to be continued in 1949. (A transcript of the discussion will be available in condensed form to those interested).

After the conference the American Alpine Club was host at its clubhouse, 113 East 90th Street. Dr. Richard Foster Flint, professor of geology at Yale, Dr. James L. Dyson, and

Mr. Maynard M. Miller addressed the meeting. Dr. Flint outlined the nontechnical observations in glacial geology that mountaineers and other travelers can make in the field; Dr. Dyson described the glaciers of Glacier National Park and suggested the type of additional observations needed; and Mr. Miller told of the reconnaissance in 1948 on the Juneau ice field and showed Kodachrome slides and films of the work.

Lecture on Northern Ireland

The second of the Series B lectures (see the *Geogr. Rev.*, Vol. 39, 1949, p. 144) was given on February 1, 1949, in Room 502 of the Engineering Societies Building, Mr. Woodfin L. Butte presiding. E. Estyn Evans, head of the Department of Geography in Queen's University, Belfast, Northern Ireland, and visiting professor at Bowdoin College, spoke on "Northern Ireland: The Land and the People." Professor Evans' abstract follows:

Northern Ireland, consisting of the six northeastern counties of the ancient province of Ulster, is one of the smallest political units in Europe, having a population of about 1¼ million. Because of close cultural and economic links with Britain, this part of Ireland insisted on remaining within the United Kingdom when the remainder of the country, now known as Eire, became politically independent. Its constitution was established under the Government of Ireland Act of 1920.

The land of Ulster offers a fruitful field for studies in environment and regional consciousness. It has been possible in this small territory to initiate many experimental surveys by close cooperation between government departments and members of the university. Belfast geographers have been assisted by the resources of various ministries, and often by their financial support, in conducting field surveys of areas of special natural beauty to be preserved and of historic and prehistoric monuments to be scheduled for protection, in excavating burial and habitation sites of various periods, in completing and publishing Land Utilisation Survey maps and memoirs, in studying rural housing conditions, house types, and rural settlement patterns, in sociological surveys to investigate rural depopulation and improve rural amenities, and in the preparation of distribution maps.

From prehistoric times, cultures penetrating the varied terrain of northeastern Ireland between the sea loughs of Londonderry and Carlingford found a southern limit along a belt of drumlins and bogs running westward. The main focus of the area thus delimited was the Lough Neagh basin. Here there was much cultural replacement, and the establishment of a strong Scottish "plantation" in the seventeenth century, following the belated conquest of this most obdurate of the Irish provinces, ensured the maintenance of a Protestant majority. The planted towns became the centers of an important linen industry, to which Belfast added shipbuilding and engineering. More than half of the Ulster towns, however, are purely market centers, and 47 per cent of the total population is classed as rural, dwelling for the most part in isolated farmsteads. These farms, worked under a well-tried system of crop rotation and animal husbandry, have ensured for agriculture first place among the industries of Ulster.

The survival of a strong rural population, owning its land but still not entirely free of kinship ties and other heritages of the past and sharply divided between Protestant and Catholic—a division that also holds good for many aspects of urban life—gives Ulster a personality differing alike from Britain and from the 26 counties of Eire. In many ways it is, paradoxically, the most representative region of Ireland; for the Ulster bridgehead, thanks to the variety of its environments, has retained some inheritance from every major

contribution to the island's history. Politically it is faced with the problem of maintaining its identity while doing justice to a large, and growing, Roman Catholic minority.

The Annual Meeting and Presentation of the Cullum Geographical Medal to Dr. Hugh H. Bennett

The Annual Meeting of the Society was held on February 15, 1949, at the auditorium of the Engineering Societies Building. Mr. Woodfin L. Butte, in the chair, opened proceedings with extracts from the report on the Society's activities for the year. Presentation of the Cullum Geographical Medal for 1948 was then made to Dr. Hugh H. Bennett, chief of the Soil Conservation Service, United States Department of Agriculture (*Geogr. Rev.*, Vol. 38, 1948, p. 318). Mr. Butte described Dr. Bennett as an eminent geographer and a past president of the Association of American Geographers, known to millions in this country and abroad as "America's great soil doctor." The citation on the medal reads: "Hugh H. Bennett—Crusader for the Scientific Conservation of Our Precious Heritage of Soil—1948."

In response Dr. Bennett expressed his deep appreciation of the Society's recognition of his work and spoke briefly of the trip to the West from which he had just returned—the severe conditions in the mountains and the attempts to rescue the livestock and wildlife starving in the deep snows. The Soil Conservation Service, he said, was giving all possible help with personnel and equipment. He expressed the fear of dangerous floods if the tremendous accumulation of snow should melt rapidly and spoke of the disaster in soil erosion and ruination of productive land to be apprehended.

Mr. Butte then introduced the speaker of the evening, Mr. William Vogt, chief of the Conservation Section of the Pan American Union and author of "Road to Survival." Mr. Vogt addressed the meeting on the general theme of his famous book (see discussion in the *Geogr. Rev.*, Vol. 39, 1949, pp. 88–89). He illustrated his lecture with excellent colored slides from Guatemala, Mexico, El Salvador, Costa Rica, Colombia, Venezuela, and Peru. Mostly the views were scenes showing misuse of the land and consequent devastation—clearing of forests, plowing on steep slopes, silting of reservoirs, the plague of goats—but two bright spots stood out. These were a small conservation service established in the Cauca River valley—Dr. Bennett had been there—and the remarkable work of the Peruvian government in conservation of the guano birds, a work with which Mr. Vogt was himself associated.

Mr. Vogt's concluding remark on the implications of "promises of peace and plenty when the population of the world is increasing by 55,000 every single day" furnished the keynote for the discussion that followed. Questions dealt chiefly with overpopulation and remedies—emigration and birth control.

A Meeting of the Steering Committee on Medical Studies

A meeting of the Steering Committee on Medical Studies was held on January 21 at the Society's building to discuss a program presented by Dr. Jacques M. May, in charge of the studies (*Geogr. Rev.*, Vol. 39, 1949, p. 145). In attendance were Dr. Gaylord W. Anderson, University of Minnesota; Commander William J. Dougherty, Bureau of Medicine and Surgery of the Navy; Dr. Saul Jarcho, Mt. Sinai Hospital; Dr. James P. Leake, National Institute of Health; Dr. Henry E. Meleney, New York University; Dr. John R. Paul, Yale University; Dr. M. C. Shelesnyak, Office of Naval Research; Dr. Arthur R. Turner, Office of The Surgeon General of the Army; Dr. Richard U. Light, President of the American Geographical Society; and staff members.

Dr. Light, presiding, opened the meeting by linking the beginning of the present program with the conference held at the Society in May, 1944. At that time the program looked forward to the production of an atlas of diseases. Now the conception has broadened to a systematic program in medical geography and good results are to be expected from a cross-fertilization of the sciences.

Dr. May then outlined his plan and program. He pointed out that research in medical geography could be conceived in terms either of (1) the geographical influences on disease or of (2) the pathological aspects of the various geographical regions. He proposed that a pilot project be undertaken along each of these two lines of approach, the one taking cholera as the subject, the other the Caribbean area as the selected region.

Dr. Paul and Dr. Leake warned against the dangers of basing important work on unreliable data. Mr. Charles B. Hitchcock of the American Geographical Society commented on the degrees of reliability in maps. It was agreed that, even though some of the data are of questionable reliability, as long as the relative reliability of the sources used is made perfectly clear, the map based on them may be useful. Dr. Shelesnyak stressed the need of studying the normal man's ecology as well as the sick man's and insisted that field work should not be neglected for indoor or laboratory work. Dr. Meleney suggested that the prospective program could use the talent of an anthropologist.

Dr. Turner urged that a general study of the geographical distribution of certain important diseases be undertaken with the aim of improving on what has been done in the past. It was the sense of the meeting that both library and field studies were needed, the emphasis on the field work depending, of course, on the amount of money available. Thorough library studies should precede field work, in view of the quantity of pertinent but unclassified and undigested data in existence. Commander Dougherty remarked that the proposed program was timely in relation to the newly expressed policy of the United States to help backward countries of the world. Dr. Anderson envisioned the ultimate creation of an institute of geomedicine.

The subject of establishing a network of correspondents was then considered, and Dr. Meleney reminded the meeting of the value of such contacts as the one already arranged with Dr. Douglas Forman of the Christian Council for Overseas work.

Acclimatization in the Andes

Because of delays in the publication program inherent in highly complex cooperative studies, the Society made arrangements with The Johns Hopkins Press for the immediate distribution to Fellows of a new book, "Acclimatization in the Andes," by Dr. Carlos Monge, director of the Institute of Andean Biology, University of San Marcos, Lima, Peru. In his foreword Dr. Isaiah Bowman explains: "Out of experimental data that have not yet been published and in the light of relevant historical material, Dr. Monge has drawn certain conclusions about biological effects in high altitudes. The whole is presented as a preliminary study to be followed by a series of scientific papers." It was in 1925 that the medical school of the University of San Marcos began its inquiries into high-altitude man. When the funds for experimental work were exhausted, Dr. Monge turned to historical investigation in the abundant archives dating from the earliest days of the Spanish conquest, with the results presented in this interesting and provocative volume.

ANNUAL REPORT OF THE COUNCIL

January 18, 1949

To the Fellows of the Society:

The following report prepared by the Director on the activities of the Society for the year 1948 is published by order of the Council.

RICHARD U. LIGHT
President

To the Council of the Society:

In our last Annual Report two priceless, if intangible, assets of the American Geographical Society were commented on: its freedom and its disinterestedness. Without these the Society could hardly have established and maintained the influence that it exerts through its publications—the 38 volumes of the *Geographical Review*, the eighty-odd books, and the distinctive maps that have appeared during the past thirty years. The quality and therefore the effectiveness of this comprehensive and unique corpus of modern geography are due largely to the Society's freedom to select and edit critically and to confidence on the part of others that the Society is a disinterested scientific institution. It would be a mistake to estimate the influence of our publications solely in terms of their limited public distribution. Although many of them are technical and although they are not read by the masses, they are closely studied by persons in key positions who speak and write with authority. Through the use made of them by teachers of teachers and writers of textbooks they have helped raise the level of geographical understanding throughout the country. This is not said complacently, for it is obvious that this level is still far too low. Indeed, the Society is now considering the challenging problem of how it might exert a more direct influence upon the improvement of public knowledge of geography without sacrifice of the values inherent in its established and time-tested policies of research and publication.

THE COUNCIL

On April 1 two important amendments to the Bylaws were adopted, in line with changes made in 1947 designed to modernize the structure of the Council and increase its efficiency of operation. The membership of the Council was fixed at 27, divided into three classes of nine, each class holding office for three years. The offices of Foreign Corresponding Secretary, Domestic Corresponding Secretary, and Recording Secretary were abolished, and an office of Secretary of the Society was established. Provision was made that membership in the Council shall not be a necessary qualification for any office except that of President. A further amendment was also adopted abolishing the class of Honorary Corresponding Members and transferring all persons listed as such on the Society's rolls to the class of Honorary Members.

The resignations from the Council of Hamilton Fish Armstrong and Frederic C. Walcott were accepted with sincere regret on January 21. At the meeting on April 1, Robert B. Hall, professor of geography at the University of Michigan, Robert S. Ingersoll, of the Borg-Warner Corporation, Chicago, and Earl B. Schwulst, of the Bowery Savings Bank, New York, were elected members of the Council.

The thorough study begun two years ago of the Society's policy and program with a view to the development of long-range plans was continued. In this connection four con-

ferences were held with outside authorities: at Baltimore, February 29, on general topics; at Kalamazoo, May 21–22, on geographical education; at Kalamazoo, June 11–12, on geographical research; and at New York, November 4, on library and bibliographical matters.

THE GEOGRAPHICAL REVIEW

Volume 38 of the *Geographical Review* introduced two new features, a Foreword and an Editorial, designed to put the reader in closer touch with the workings of the Society and with the ideas back of its quarterly journal. The Foreword by the President describes phases of the Society's activities as a growing organism and problems attendant on that growth. There is the physical problem of space to accommodate the rapidly expanding collections—books and maps—and the increased staff to handle them. As Dr. Light points out, a great library is people as well as documents and is to be judged not by size alone but by its vitality. The increasing number of projects in hand and under consideration raises urgent questions of financing. Although many of the projects are of a scope undreamed of in early days, exploration of unknown lands still remains an obligation of a geographical society, as was so well illustrated by the Society's interest in the Ronne expedition to the Antarctic.

The Editorial tells some of the varied stories behind each number of the *Geographical Review;* for example, how a British geographer was called to Pakistan as adviser on its boundary problems; how experiments of a consulting climatologist engaged in crop research for a food-processing company helped in formulating a climatic classification. More especially, the Editorial focuses on qualities and functions of geography revealed in the wide range of contributions to our journal: the newness and timeliness of material from all over the world made available by speedy communications, by air mail, radio, overseas telephone; the geographer's fundamental attribute of a passion to explore *terrae incognitae,* literal or figurative; the place of geography in the solution of the world's enigmas, from the question of landownership on a minute Micronesian atoll to the problem of whether the Atlantic coast of the United States is sinking. Over all is the conclusion of the unity of the knowledge to which geography contributes its share.

LIBRARY AND MAP DEPARTMENT

During the year 805 books, 598 pamphlets, 1778 complete volumes of periodicals (6457 parts), 27,051 maps, 136 atlases, and 950 photographs were added to the collections, which now number 122,288 volumes of books and periodicals, 24,587 pamphlets, 178,570 maps, 2612 atlases, and 32,464 photographs. As compared with the previous year the number of consultants increased about 20 per cent to a total of 1370, and telephone inquiries about 70 per cent, to 877. To the various catalogues 15,771 cards were added.

The growth of the map collection continues by leaps and bounds. Up to 1944 we were receiving two or three thousand maps each year; the figures for 1944–1948 run as follows: 10,037, 10,644, 11,810, 13,371, 27,051. While most of these maps are coming in as gifts from various agencies of the United States government, and especially the Army Map Service under its depository program, foreign governments, commercial firms, other institutions, and individuals have also been most generous, and we extend grateful thanks to all concerned. This deluge of maps would be an embarrassment of riches were not the pressing problem of space one that can some day be solved, whereas today's golden opportunity to secure the maps will not be repeated. Duplicate and unwanted maps were given to certain libraries, and a quantity of school maps were sent to the Galilean Children's Home in the

Kentucky mountains, where they were sorely needed. Among the more important acquisitions was a set of 34 restrikes of eighteenth-century charts of the Atlantic and Gulf coasts of the United States from Des Barres's "Atlantic Neptune," kindly donated by the British Admiralty.

Representatives of some of the largest libraries in the country attended a conference at the Society in November on our collections and bibliographical activities, at which many helpful suggestions were made.

Volume 11 of *Current Geographical Publications* was completed; the demand for this bibliographical aid has been greater than ever. References were supplied to the Association de Géographes Français for the *Bibliographie Géographique Internationale*. The bibliographical resources of the Society were made available to a number of libraries which have purchased copies of the microfilm made in 1940 of our Research Catalogue.

NEW BOOKS AND MAPS

During the year the Society published "The Coast of Northeast Greenland," by Louise A. Boyd and others. The volume comprises the narrative and scientific results of Miss Boyd's expeditions to Greenland in the summers of 1937 and 1938 and is accompanied by a slip-case containing large-scale topographic maps of several specific areas, echo-sounding profiles, bathymetric charts, and a number of photographic panoramas. The third decennial index to the *Geographical Review*, covering 1936–1945, also appeared.

A new map, The World, equatorial scale 1 : 30,000,000, on a modified Mercator projection developed by O. M. Miller of the staff and prepared by the Society for the Department of State, was made available to the public. Of the two remaining sheets of the Society's Map of the Americas, 1 : 5,000,000, the sheet covering the United States and southern Canada was published in the fall and the sheet for northern Canada, Alaska, and Greenland was in the hands of the printer at the end of the year. One revised sheet of the Map of Hispanic America on the Scale of 1 : 1,000,000, Piura (South B-17), was issued, and recompilation and redrafting of twelve additional sheets were in progress.

FIELD STUDIES AND OTHER RESEARCH

The Society's program of glacier studies was continued both in the field and in the assembly of data and photographs. A long-term program of comprehensive studies of the upper parts of certain glaciers was begun in Alaska, and plans were initiated to extend the observations to South America in 1949. During the summer Maynard M. Miller, research assistant, took part in field investigations of the Juneau ice field in Alaska, and W. O. Field, Jr., who is in charge of the program, undertook some observations in the Canadian Rockies.

During January and February Mr. Charles B. Hitchcock for the second time participated as geographer and geologist in an expedition to southern Venezuela led by Mr. William H. Phelps, Jr., of Caracas. In October and November Mr. Hitchcock visited the Argentine Republic, traveling as far south as Ushuaia, in Tierra del Fuego.

A grant-in-aid from the Upjohn Company, Kalamazoo, made it possible for the Society formally to inaugurate its program of studies in medical geography on November 15, when Dr. Jacques M. May, a French surgeon who has had an active career in the tropics, was put in charge.

Mr. O. M. Miller continued his research in the field of photogrammetry. He completed the first part of a manual of map sketching from aerial photographs.

MEDAL AWARDS AND ELECTIONS TO HONORARY MEMBERSHIP

At a meeting of the Council on February 17, the Cullum Geographical Medal was awarded to Dr. Hugh H. Bennett, chief of the Soil Conservation Service, United States Department of Agriculture; the Charles P. Daly Medal to Professor Henri Baulig, professor of geography at the University of Strasbourg; and the David Livingstone Centenary Medal to Professor Frank Debenham, professor of geography at Cambridge University.

At a meeting of the Council on May 18 seven Honorary Members were elected: Charles H. Behre, Jr., professor of geology at Columbia University; Owen Lattimore, director of the Walter Hines Page School of International Relations of The Johns Hopkins University; John Barger Leighly, professor of geography at the University of California, Berkeley; George McCutchen McBride, professor of geography, University of California at Los Angeles; Robert Larimore Pendleton, professor of tropical soils and agriculture, The Johns Hopkins University; George Henry Hamilton Tate, curator of mammals, American Museum of Natural History; and Charles Warren Thornthwaite, distinguished consulting climatologist.

COLLABORATION IN OTHER ENTERPRISES

Once again it is gratifying to record the active participation of members of the staff in the scientific work of other organizations. Mr. Charles B. Hitchcock, Assistant Director, served as a delegate of the United States and representative of the Society at the Fourth Pan American Consultation on Cartography of the Pan American Institute of Geography and History at Buenos Aires. He also served as treasurer of the Association of American Geographers and as chairman of the United States Advisory Committee on American Cartography. Mr. O. M. Miller represented the Society at the Sixth International Congress on Photogrammetry at The Hague in September. He was also chairman of a technical subcommittee in the Division of Geology and Geography of the National Research Council and was a member both of the Board of Direction of the American Congress on Surveying and Mapping and of the Advisory Council of the Department of Civil Engineering, Princeton University. Mr. W. O. Field, Jr., succeeded the late Dr. F. E. Matthes as chairman of the Committee on Glaciers in the Section of Hydrology of the American Geophysical Union. He also represented the Society on the Division of Geology and Geography of the National Research Council, and Mr. Raye R. Platt represented the Society on the Council of the American Association for the Advancement of Science. The Society's Map Curator, Miss Ena L. Yonge, and its Librarian, Miss Nordis Felland, attended a Special Libraries Association convention at Washington in June, the former serving as chairman of the Geography and Map Group. At the meeting of the American Library Association in Atlantic City, Miss Felland, representing the New York Regional Catalog Group, of which she is president, spoke at a luncheon of the Council of Regional Groups. Dr. John K. Wright served as a member of the Council of the Association of American Geographers, as chairman of the Committee on Geographical Exploration of the Research and Development Board of the National Military Establishment, and as chairman of the Jury of Award for the Loubat Prizes awarded every five years by Columbia University. In December, Mr. R. H. MacMurphey of the Council and Dr. Wright, Mr. Hitchcock, Dr. Jacques M. May, and Mrs. Wilma B. Fairchild of the staff participated in the annual meeting of the Association of American Geographers at Madison. In June a tea was held at the Society's building in honor of a visiting group of members of the Société de Géographie de Lille, France.

LECTURE PROGRAM

The speakers and titles on the Society's program of lectures delivered at the regular meetings during the year were as follows: January 20, Dr. Hugh H. Bennett, "Soil Conservation in a Hungry World"; February 17, Dr. Charles H. Behre, Jr., and Dr. H. L. Shapiro, "Understanding Mexico"; March 16, Mr. Deane Dickason, "There Is No India"; November 16, Mr. Murl Deusing, "Safari in Africa"; November 30, Mr. Junius B. Bird, "Early Inhabitants of South America."

The regular meeting on April 16 took the form of a welcoming reception for the Ronne Antarctic Research Expedition, which was under the auspices of the Society and had landed in New York upon its return from the Antarctic on the day before. A delegation from the Society, including Dr. Richard U. Light, President, met the ship at the dock, and before the formal reception the Society gave a dinner in honor of the party, at which were present their families, members of the Council and staff of the Society, and other guests.

In November a new system for the lecture program was initiated. Each season will include four lectures similar to those of former years and four lectures less formal in nature, which will provide an opportunity for reports of recent field work and for the presentation of more technical and scientific subjects of geographical interest.

Informal talks were also given at the Society's building for members of the staff and a few guests. Mr. Maynard M. Miller talked on his 1946 and 1947 trips along the Alaskan coast for glaciological research; Mr. William H. Phelps. Jr., described his recent expedition to Venezuela; and Mr. Charles B. Hitchcock spoke on his trip to Argentina.

FELLOWS

The number of Fellows on December 31 (including persons who had signified their desire to join but were still awaiting formal election) was 4491, of whom 11 were Benefactors, 8 Patrons, 166 Life Fellows, and 50 Sustaining Fellows.

JOHN K. WRIGHT
Director

ELECTION OF OFFICERS AND COUNCILORS

At the Annual Meeting of the Council hild on January 18, 1949, the following-named gentlemen were elected to the offices designated:

		Term to expire in
President	Richard U. Light	1950
Vice-President	William A. Rockfeller	1950
Vice-President	William Hale Harkness	1950
Vice-President	J. Clawson Roop	1950
Secretary	John K. Wright	1950
Treasurer	R. McAllister Lloyd	1950
Councilors	G. Lister Carlisle	1952
	William Hale Harkness	1952
	Archer M. Huntington	1952
	Richard U. Light	1952
	R. McAllister Lloyd	1952
	Thomas W. Palmer	1952

GEOGRAPHICAL RECORD

NORTH AMERICA

ICE FOGS IN THE INTERIOR OF ALASKA. A hazard to aviation in interior Alaska is the occurrence of ice fogs in the immediate vicinity of towns when visibility is good elsewhere, as V. J. Oliver and M. B. Oliver point out in an article with the above title (*Bull. Amer. Meteorol. Soc.*, Vol. 30, 1949, pp. 23–26). At Fairbanks a persistent type of ice fog occurs when the temperature drops to −40° F. That smoke is the cause is readily apparent (it is pointed out that moisture in the smoke nuclei may be the actual factor). During periods of extreme cold, winds are mainly from the north and northwest, downslope drainage winds. Fog is thickest at the east end of the runway, nearest town and in the path of the drainage winds. The situation can be matched elsewhere, and the authors conclude that "the ideal location of an airport in most instances would be between the town and the nearby hills, rather than between the town and the river where most of interior-Alaskan air strips are now located."

THE RAILROADS OF THE UNITED STATES. In 1935, while I was a graduate student at Harvard, Professor Jules Blache of the University of Grenoble was visiting professor of geography. One of the tasks he set himself was the collection of American railroad timetables for his colleague Professor Maurice Pardé, distinguished hydrologist at Grenoble, whose hobby was railroads. For many years Professor Pardé had prepared an annual note for the *Annales de Géographie* on the fastest train schedules in the world, which, before 1933 or thereabouts, were all in Europe. I took great pleasure therefore in marking some recent timetables showing new fast trains in our Middle West, which not only exceeded speeds in the eastern part of the country (and still do) but also became the largest block of fast trains in the world (and, needless to say, still are). Professor Pardé seized on this information with avidity and in his succeeding annual surveys enthusiastically noted the American train speeds. His enthusiasm for American railroads has continued and probably reaches its high-water mark in his recent article "Les chemins de fer des États-Unis" (*Annales de Géogr.*, Vol. 56, 1947, pp. 274–294).

Professor Pardé points out that United States railroads have no equal in the world for length of lines, enormousness of traffic, strength and power of matériel, and efficiency of operation. Some figures bearing out this contention are: (1) average weight of rail, 54–70 kilograms and more per meter (43–50 in Europe); (2) axle loads permitted on track and bridges, 30–35 tons (18–20 in France, 20 in Germany, 22 in Great Britain, 23 in Belgium); (3) about one-third of track provided with some form of automatic signaling (about one-tenth in France); (4) large size of freight cars (four times the number of French cars but 11 times their capacity); (5) heavy freight trains pulled by large engines (maximum train weights in the United States, 10,000–13,500 tons, as compared with 1600–2000 tons in France); (6) remarkably long distances run by engines without changing and resulting greater average distances covered per month (30,000 kilometers and more for the most modern steam locomotives, as against a maximum of 6000 in France; freight and passenger cars likewise covered more miles in the United States).

Other fundamental differences are: (1) the remarkably small number of passengers carried, practically the same as in France (though passenger-kilometers are greater); (2) the

much greater number of ton-kilometers carried (12–15 times more than in France or Germany before the war), though total tons carried were not a great deal more than in Great Britain, France, or Germany (depending somewhat on the year); and (3) the insignificant number of local trains (exclusive of commutation), probably reflecting principally highway competition.

Professor Pardé describes some of the major distinguishing characteristics of American railroads with great skill, even though he was faced with the difficulty of working at arm's length without benefit of local information, and his article may be regarded as complementary to my study, "The Railroad Pattern of the United States," in this number of the *Geographical Review* (or perhaps vice versa, since his article was published first!). He makes remarkably few errors, most of which are minor, such as referring to the Atchison, Topeka and Santa Fe as the Topeka rather than the Santa Fe and the mislabeling of a few lines on the one map in the article.

In conclusion, Professor Pardé's paper provides two general examples of procedure that should recommend it to all modern geographers: (1) the insistence that to advance the important geographical aspects of transportation it is necessary to go into some technical detail, just as the industrial geographer does when studying industry (or any geographer should do in any branch of geography); and (2) the complete lack of national bias, exemplified by the fair and generous appraisal of a segment of American life. Geography handled in this honest, scholarly fashion should certainly aid in world understanding.—EDWARD L. ULLMAN

CENTRAL VALLEY PROJECT: DECENNIAL PROGRESS REPORT. Ten years ago this month the *Geographical Review* outlined the background and main features of the Central Valley Project, a master plan for water development in interior California that was just getting under way. Since that time, despite delays caused by such factors as wartime shortages of manpower and electrical equipment, the project has become a going concern.

"The Thirsty Land: The Story of the Central Valley Project" by Robert de Roos (Stanford University Press, 1948) is the first popular book on the project. Although written primarily as history, the book develops a distinctly geographic theme: the development of a man-made landscape through the interplay of diverse natural and social factors. The role of the natural elements is sketched in more lightly than a geographer would wish; chief emphasis is placed where every good newspaper man would place it, on the series of conflicts that have been waged over the birth and development of the project. The referendum campaign of 1933 that brought the project into existence, the continuing contest between the private-utility and public-ownership groups, between the big and little farmers, between the Corps of Engineers (Department of the Army) and the Bureau of Reclamation (Department of the Interior), and many lesser skirmishes, are traced in detail. Today it can hardly be denied that the development of the culture landscape may be affected as much by the outcome of a struggle between two sets of interests as by cycles of erosion, distribution of soil types, and the other environmental factors that so long have been accepted themes of geographic research as causal factors.

Although De Roos, a featured journalist for the *San Francisco Chronicle*, forthrightly announces on the first page his bias as being on the side of public ownership, the small farmer, and the Reclamation Bureau, he presents the opposition arguments fairly and at

length. The study is a sound and valuable compilation and should occupy an important place on the shelf of anyone concerned with California geography or with national issues of water and power development.

With the aid of "The Thirsty Land," which carries Central Valley developments up to the spring of 1948, supplemented by basic studies and, in February, 1949, by a personal interview with Richard Boke, regional director of the Bureau of Reclamation for the Central Valley, the reviewer has made the following brief progress report. The biggest element of the project, Shasta Dam on the Sacramento River, is virtually completed with finishing touches now being put on the drum gates of the spillway. It already has helped reduce winter floods and since June, 1944, has been generating power. The last of the five generators is being installed this spring; it will bring the generating capacity of Shasta to 375,000 kilowatts. Keswick Dam, nine miles below Shasta, is now completed, and its generating plants, with a total capacity of 75,000 kilowatts, will be in operation by the end of the year. The Contra Costa Canal is providing domestic, industrial, and irrigation water in the area southwest of the Delta. Friant Dam on the San Joaquin River is completed, and Millerton Lake, its reservoir, is already attracting bass fishermen. The Madera Canal, running north from Friant, is completed and in use, and the longer Friant-Kern Canal, running south, is virtually finished and partly in use. Plans for a high-level canal along the west side of the valley from the Delta to Mendota replace the original lower San Joaquin River pumping scheme. A steam-electric power plant is to be built south of the Delta near Tracy when funds become available, to "firm up" the hydroelectric power of the system, and will be connected with Shasta by transmission lines along the east and west sides of the Sacramento Valley. The east-side transmission line already has grown from Shasta to Sacramento via Oroville, and the west-side line now extends 27 miles from Shasta.

Following the lead of the Southern San Joaquin Municipal Utility District, two irrigation districts in the hard-pressed San Joaquin Valley have recently approved contracts with the Bureau of Reclamation for purchase and distribution of water. Negotiations are in progress for municipal power sales. To date, a private utility has been the sole purchaser of power. The wisdom of developing power at Shasta has become increasingly evident. Precipitation has been subnormal in California in the past three winters, with the result that water and hydroelectric power have been in desperately short supply. The electricity "brownouts" in the winter of 1948 showed that instead of having a 15 per cent reserve capacity, considered the minimum for safe operation, the California power system had no reserve at all. The power shortage, though still serious, was a little less pressing in the winter of 1948–1949, partly as a result of the installation of two additional generating units at Shasta Dam in 1948.

Recent changes in federal legislation affecting the priorities of various uses of reclamation water are important to the entire arid West. The Rivers and Harbors Act of 1937, which placed the Central Valley Project under federal reclamation law, continued the existing formula under which first priority went to river regulation, improvement of navigation, and flood control; second priority to irrigation and domestic use; third priority to power. The Flood Control Act of 1944, recognizing geographic realities, specified that west of the 98th meridian irrigation and other consumptive uses should have priority over navigation.

Plans for ultimate development of the water resources of the Central Valley watershed include dams and reservoirs in the mountains on most of the important streams. As the

project grows, the concept of utilization broadens. The idea of multiple-purpose dams, with two or more uses, such as flood control, irrigation, navigation, power, and recreation, is now being applied to the entire interconnecting system of water controls in the region. Still broader concepts, covering interregional relationships, have begun to appear in the thinking on Western developments. Thought is being given, for example, to interconnection of the Central Valley and Bonneville power systems. Bonneville Dam, on the Columbia River, is a run-of-the-river project, with little water-storage capacity. Its unused off-peak capacity might be utilized to send power to the California network and thus allow Shasta Reservoir to conserve additional amounts of water at times. Important seasonal differences are involved. Unlike the Central Valley of California, the territory served by Bonneville does not have a large pumping load in summer. Finally, at the time when runoff on the Columbia River is contracting as a result of headwater freezing in the northern Rockies, the California rivers are beginning to swell from the winter rains.—PEVERIL MEIGS

SOUTH AMERICA

THE SHIFTING CHANNELS OF A BOUNDARY RIVER, THE PILCOMAYO. The first number of the *Anales*, a new series among the publications of the Dirección de Minas y Geología of the Argentine government (Secretaría de Industria y Comercio, Buenos Aires, 1947), is devoted to a report by I. Rafael Cordini on "Los ríos Pilcomayo en la región del Patiño." It describes the studies conducted by the Dirección on which was based the final decision regarding the Argentine-Paraguay boundary in the Punto Horqueta–Salto Palmar section of the Pilcomayo River as incorporated in the Complementary Treaty of June 1, 1945 (see note on the "Argentine-Paraguay Boundary Treaty," *Geogr. Rev.*, Vol. 36, 1946, pp. 153–154). This is a section in which the river course is not a single, well-defined bed but a stretch of swampland and shifting channels, which make extremely difficult the interpretation of the boundary defined in the treaty of 1876 as following the river from its mouth to the Bolivian frontier. The problem set for the field investigators was to make a thorough study of the 4000 square miles of the area, with special attention to the principal channel. It was found that "the river changes its course so frequently that it was not possible to speak of a principal channel except with reference to the exact moment of observation." The report leaves no doubt that the investigation was thorough, including the analysis of a large number of geological samples and soil profiles, meteorological observations, analysis of the chemical cycle of the waters in the various channels and wet-season lakes, detailed topographical survey, and botanical collections. The findings are presented in detail, and the report is copiously illustrated with maps, profiles, and photographs, but no hint is given as to just how a boundary commission would make use of this material in determining the exact course of an international boundary.

EUROPE

OXFORD, A MULTIFUNCTIONAL CITY. Oxford has seen great changes in the last 50 years. The gray beauty of the poet's "towery city, cuckoo-echoing, bell-swarmèd, lark-charmèd, rook-racked, river rounded," has been dimmed by the addition of a "base and brickish skirt." Or, as E. W. Gilbert has it, old Oxford has been "surrounded by a great red rash" (The Industrialization of Oxford, *Geogr. Journ.*, Vol. 109, 1947, pp. 1–25). The population of nearly 50,000 in 1901 has more than doubled, largely through the introduc-

tion of the motor industry—the establishment of what is now the Nuffield Organization and the Pressed Steel Company (making car bodies). In 1936, according to a market survey, Oxford shared with Coventry and Luton first place as the most prosperous town in Britain. The selection of Oxford as an industrial location was fortuitous and due to one man, William Morris, now Lord Nuffield. The locality has no resource of raw materials or power. There are, it is true, advantages of situation: Oxford is equidistant, 60 or 70 miles, from London, Southampton, Bristol, and Birmingham. The site has certain disadvantages, however. The old walled town occupied a cramped location at the southern tip of a gravel terrace. Early extension was mainly northward, and the north-south alignment is still visible on a land-use map of the city. "In the west are the Thames and its meadows; inside the city boundaries no less than 160 acres are occupied by rivers and canals and a large acreage is liable to flood. Next comes the blighted area of stations, gasworks, and St. Ebbe's, and then the commercial area of Cornmarket, the main shopping centre of Oxford. Then there is the large University area on both sides of the High Street. Educational bodies, hospitals, and other institutions cover as much as 1250 acres of the city, one-seventh of its total area. The Cherwell valley is succeeded by the residential areas east of Magdalen Bridge and finally by the factories at Cowley. Large industries and Public Utility undertakings cover 400 acres in the city."

The ills arisen from the uncontrolled development of the past are all too apparent now that questions of the future are urgent. In 1945 the Oxford City Council appointed Thomas Sharp as town-planning consultant. His report, "Oxford Replanned," is now published. Like Mr. Gilbert, he asks the question, "What sort of town is Oxford to be?" And answers, "The prime function of the future city should be as a university city and a county and regional capital." He considers that, "in the interest both of the city's social well-being and of its historical character, the great Nuffield and the Pressed Steel works should be removed" and new factories, "of the right kind, in the right proportion, and in comparatively small units," should be brought in. The city "should preferably decline in size to a population of 90,000 or slightly less."

Mr. Sharp's summary of main recommendations lists 52 items, large and small. Some of them relate to the enhancement of Oxford as a tourist center, a role that has been neglected in the past, as Mr. Gilbert also points out at some length. The report has the customary equipment of attractive plans in color and a large number of magnificent photographs, which convey a feeling for the very fabric of the city.

THE RECONSTRUCTION OF VIENNA. The reconstruction of war-damaged Vienna affords an opportunity to put into practice modern ideas of city planning. Walter Strzygowski, a former Austrian exchange student at the University of Colorado and prewar lecturer at the Geographical Institute of the University of Vienna, discusses the subject in a 62-page monograph, documented with numerous maps, sketches, statistics, and bibliography (Die städtebauliche Zukunft Wiens: Vorschläge für die künftige Gestaltung der Stadt [cover title: Die Neugestaltung der Stadt Wien], *Österreichische Beitrage zur Kulturforschung*, Vol. 1, Vienna, 1948).

In any consideration of the future of Vienna, its changed position and function since World War I must be kept in mind. Thirty years ago it was the political capital and economic center of a 60-million empire. Now its political status is that of the capital of a seven-million state, and its position with respect to the trade and transportation pattern of Central

Europe has declined progressively as the nationalism of the other former members of the empire increased. One result of this has been a steady decrease in the importance of the Danube as a transportation artery and the consequent failure to improve or even to maintain its navigation and harbor facilities. Since the beginning of World War II many industrial establishments have moved from the city. In July, 1946, Vienna had an estimated population of 1,618,000, as compared with 2,031,421 in 1910, and 1,930,000 in 1939; the loss of several hundred thousand residents during World War II has been only partly made up by immigration from South and Southeast Europe.

Strzygowski rejects any plan for the city that involves wholesale movement of industry and industrial workers to the provinces; he argues that further decrease in Vienna's importance as an industrial center would make it a dead city. He does, however, emphasize the necessity (and opportunity) for decentralization and resettlement within the city limits. According to his plan, only the old town (*Innere Stadt*) would remain as it is, except for certain modifications in rebuilding the devastated section between Stephansplatz, the Danube Canal, and Praterstern. Industrial establishments would be concentrated in the southeast and east between Achau and Breitenlee. Bordering this area would be small settlements mainly for industrial workers consisting of two- to four-family houses with garden plots in which vegetables could be grown to relieve the serious food deficiency from which Vienna has suffered ever since World War I. Special suburban settlements would be devoted to educational and medical establishments, and numerous small garden cities connected with one another and with the central district by modern highways and possibly by rapid-transit lines would be established. Wienerwald, the beautiful forested hills to the west and northwest, is suggested as being particularly suited to garden settlements and recreation areas. Fast transportation into the city would be provided by the many existing railroad lines and by the present valley roads, if they were widened, as could be easily done.

Strzygowski also suggests, as immediate needs for Vienna, the thorough modernization of both river and rail terminal facilities, including the installation of loading and unloading equipment on the wharves and the deepening of the Danube Canal, the building of two modern railroad stations in place of the seven old ones, in partial disuse before World War II, and the development of freight belt lines and modern highways to connect and serve the various sections of the city. The need for a modern airport is obvious. In the larger view, Strzygowski envisages a unified plan for the Danube Valley modeled on TVA and embracing hydroelectric development, reforestation, soil conservation, and modernization of farms as well as many improvements in navigation and harbor facilities necessary to make the river again useful in European transportation. These include the deepening of the navigable channel and a system of canals to connect the Danube with rivers to the north.—GEORGE W. HOFFMAN

ANNIVERSARY VOLUME OF THE JOURNAL OF THE ROYAL NETHERLANDS GEOGRAPHICAL SOCIETY. On the occasion of its 75th anniversary the Royal Netherlands Geographical Society has published a special number of its journal (July-September, 1948), devoted to various aspects of aerial photography. More than 30 articles cover a wide variety of subjects and demonstrate the remarkable recovery of the society after the difficult years of war and occupation.

An introductory article deals with the possibilities and difficulties in the interpretation

of vertical aerial photographs. The first part of the number is concerned with certain aspects of the economic recovery of the Netherlands after World War II; it is illustrated with oblique aerial photographs. In the second part the aerial photograph is used as a means of analyzing and interpreting cultural and natural features of the earth's surface, such as patterns of settlements and their historical development, landforms, and geological and archeological phenomena. Examples are the articles by H. Halbertsma and D. de Waard on archeological research in the Netherlands. In the northern part of the country, especially in Friesland, are a great number of terps (mounds), covering sites of prehistoric settlements. They were made by the inhabitants for protection against the invading sea when dikes either did not exist or were inadequate. In the last century much of the fertile soil of the terps has been removed and spread over adjacent lands, and their exact sites have thus been obscured. Aerial photographs help in tracing the terps and also the drainage pattern, which largely determined their location. In the recently completed Northeast Polder, which includes the former island of Urk, an old network of ditches is revealed; in prehistoric and early historic times they must have been part of a greater Urk.

The interesting thing about the terps and the ditches is that they not only furnish indications of human activities many centuries ago but also contribute to a better understanding of the recent geological history of the Netherlands. The terp profiles show several layers of earth that are considered by archeologists to be old surfaces of occupation. These are at such heights relative to sea level that a positive change of the latter seems to be an inevitable conclusion. This is true also of the network of ditches near Urk. According to D. de Waard, the positive change of sea level amounts to about one meter for the last 10 centuries.

Of importance to the American reader are two articles in English, one by G. L. Smit Sibinga, "On the Geomorphic and Geologic Analysis and Interpretation of Aerial Photographs," the other by J. J. van Nouhuys, "Geological Interpretation of Aerial Photographs." —J. J. Groot

NEW FRENCH PERIODICALS ON HUMAN AND ECONOMIC GEOGRAPHY. Material difficulties do not prevent French geographers from starting new magazines—two new periodicals appeared in 1948. Professor Pierre Deffontaines, who follows the path opened by Jean Brunhes, and an ethnographer, Professor André Leroi-Gourhan, with the help of the publishing firm of Gallimard, have launched a beautifully printed *Revue de Géographie Humaine et d'Ethnologie*. The first number (January–March, 1948) carries a challenging foreword: the editors endeavor to break down the partition erected between human geography and ethnography, both studying the *homo faber*. Man's action in shaping the conditions in which he lives is thus a central theme. Establishing contacts between different approaches should be more fruitful than adding to the partition. The new quarterly's first two numbers endeavor to carry out this policy: most of the articles are on the divide between geography and ethnology. Mountain modes of life, villages of certain tribes in Madagascar, the Uralo-Altaic family of languages, and the blacksmith in Black Africa are among the subjects treated. George F. Carter tells about Indians and maize; René David about geography and law. A concise, well-illustrated article shows the part the vehicle might play in social research. Geographical and ethnographical events and meetings throughout the world are recorded.

Bordeaux suffered badly during the war, yet in this time of reconstruction it manages to sponsor a new periodical. *Les Cahiers d'Outre-Mer: Revue de Géographie de Bordeaux et de*

l'Atlantique is a quarterly published under the joint sponsorship of the department of geography of the University of Bordeaux (Professors Louis Papy and Eugène Revert are the editors), the local Institute of Overseas France, and the Société de Géographie Commerciale of Bordeaux.

The old specialization of Bordeaux as a port trading mostly with the countries southward around the Atlantic has put its imprint on the first three numbers (January, April, and July, 1948). The opening article, by Pierre Gourou, covers the general problems of the development of tropical countries; the reconstruction of Bordeaux, the economy of Martinique, bananas in the Ivory Coast, a study of the Brazilian northeast, settlement in the New Hebrides, and the city and port of Casablanca are reviewed in other articles, all well documented. An article by Henri Enjalbert on "European Agriculture in South America" surveys a vast and rather ill-defined field—the term "European agriculture" could be debated at length. The author means the whole development stemming out of the settlement by Europeans. His attempt at a synthesis is interesting but not always convincing. To explain the exportable surplus of foodstuffs of the Atlantic countries in South America, the Pampa included, only by the low wages and low standards of living of the rural workers seems peculiar. Similar lands in North America (the Great Plains, the Canadian prairie, etc.) also have a considerable exportable surplus, and nobody would speak there of low standards. The actual problem is something else, though it is certainly related to social and economic factors rather than to natural conditions.

The good start made by these two new periodicals emphasizes once more the growth of interest everywhere toward the human side in geography.—JEAN GOTTMANN

ASIA

THE FODDER RESOURCES OF PALESTINE. We are constantly being reminded that Palestine is a land of contrasts; in the field of animal husbandry, for instance, there could hardly be a greater contrast than that between the Jewish dairy farm with its pedigreed stock and its dependence on irrigated fodder and purchased concentrates and the Arab fellah's small flock of low-grade goats, busily engaged in degrading still further the already degraded vegetation of the hills. Both have their problems. R. O. Whyte of the Imperial (now Commonwealth) Bureau of Pastures and Field Crops, Aberystwyth, examines them in a report on "The Fodder Resources of Palestine" (Jerusalem, 1948).

In part under wartime stimulus, fodder production for the dairy industry increased from less than 100,000 tons in 1937 to more than 200,000 tons in 1944; during that period milk production about doubled, but its cost (producers' prices) increased nearly fivefold. Fluid milk must now face competition from the dried and condensed product. To cut the costs, it is suggested that as much fodder as possible be grown under winter rainfall and conserved as hay and silage. On the poor hill lands the problem of grazing is "almost insoluble" if the existing animal population is maintained, let alone increased, as the human population increases. "If all the bare rocky hills of Palestine could be freed from burning, cutting and grazing for 20 years, they would become covered with a vegetative cover of the garigue or maquis type, with a winter ground cover of annual grasses . . . Such a cover could still carry a considerable sheep population probably without suffering serious damage, but the re-introduction of the goat would cause it to deteriorate again to its present state. . . . The only hope seems to be that the Arab farmers . . . will terrace *all* their hill land and

therefore of necessity have to abandon stock keeping on the present extensive scale." The problem is primarily a human one—how, for instance, to persuade the Arab that four or five tethered and partly hand-fed goats would give him as good a return as a score of free-ranging animals? If this could be done, it would be a good beginning; for 60 per cent of the estimated 300,000 goats are held in flocks of 10 to 20. The only hope for solving the human problem involved seems to be to "educate a team of young Arab officers in modern achievements and methods in animal breeding and animal husbandry."

Dr. Whyte's recommendations range from research in the phytogeography of the country to details of husbandry practices. He points to a detailed study of the hydrologic cycle as eminently desirable and gives some interesting comparisons. In Palestine "the average annual total amount of flow in all the surface springs, streams and winter torrents is only 1,400 to 1,800 millions of cubic metres. For comparison, the Tennessee and Tigris are 31,000 million c.m., the Nile three times that. The flow of the Jordan is less than 3 per cent of either the Tigris or Tennessee and about 1 per cent that of the Nile. Egypt has enough water in the Nile for 5,000 c.m. per person, per annum, Iraq in the Tigris 10,000 c.m., Palestine only 1,000."

HUMAN GEOGRAPHY

WORLD FIBER SURVEY. "Clothing and household textiles generally absorb a larger share of consumer expenditure than any other group of consumer goods except food." With this statement the Food and Agriculture Organization of the United Nations begins a study of production of, and trade in, textile raw materials (World Fiber Survey, Washington, D. C., 1947). The bulk of the report deals with natural fibers, and it starts out by defining certain characteristic features in their economy: the high ratio of world exports to world production; the high degree of geographical concentration of production for export; the importance of fiber crops in the economies of the producing and exporting countries.

The exacting climatic and soils requirements of fiber plants limit the production areas. "The bulk of the world's vegetable fibers is produced in the lands lying approximately between 35° North and 25° South Latitude. This generalization applies to all cotton culture except that of the U.S.S.R., northern China, and Argentina. It covers jute and abaca, . . . and it is true of sisal . . . The exceptions are flax and hemp." The following percentages illustrate the concentration of production for export, 1934–1938: cotton, 84 from the United States, India, Egypt, and Brazil; wool, 80 from Australia, Argentina, New Zealand, and South Africa; silk, 77 from Japan; flax, 54 from the Soviet Union and Belgium; jute, 98 from India; abaca, 95 from the Philippines; sisal, 50 from British East Africa; henequen, 92 from Mexico. The international trade in fibers immediately before the war took more than one-half of all agricultural raw materials exported and about one-quarter of the export of all agricultural products. This is out of all proportion to the producing area as far as the vegetable fibers are concerned. In the United States land under cotton in 1939 represented less than 8 per cent of the total harvested, but cotton absorbed 21 per cent of all man-hours spent on crop production. It is estimated that jute cultivation in India requires a working population of 1000 to the square mile. Cotton is the "principal source of cash income for millions of farmers in different parts of the world. In the United States . . . average receipts from cotton and cottonseed during 1934–38 accounted for 40 percent of total cash receipts of farmers in the ten principal cotton states."

The demands for clothing are the result of far more complex factors than food requirements. Besides climate, standard of living is a prime consideration. The report includes some interesting graphs showing the relation between real income and consumption of clothing fibers, also a graph of consumption of major apparel and household fibers in continental Europe (exclusive of the U.S.S.R.) on the eve of, during, and after World War II; most striking is the shrinkage in cotton consumption and the gain in rayon. The cotton industry is essentially a product of the nineteenth century. "It is estimated that at the end of the eighteenth century cotton provided only about 4 percent of the world's textile raw materials," wool 78 per cent. The Industrial Revolution transformed the industry; on the eve of World War I cotton accounted for more than 84 per cent of the chief clothing fibers, wool 15 per cent. But already a "scientific revolution" was beginning; it was greatly accelerated by World War II, and development continues in a "dynamic" stage. "Not only has the range of raw materials been widened but new fibers and new processing methods also make for an increasing degree of interchangeability of raw materials." Rayon is a semisynthetic based on cellulose, chiefly wood pulp; Sweden supplies a quarter of the industry's present requirements, but the range of raw material and the geographical production areas are constantly widening. As a result of this and the rapid growth of nylon and other true synthetics, the characteristics of the industry set forth in the first paragraph of this note are undergoing modification.

OBITUARY

WILHELM CREDNER. Wilhelm Credner, professor of geography at the Institute of Technology and professor of economic geography at the University of Munich, died suddenly on October 13, 1948, in Munich. His death represents a severe loss to German geography, laboring at present under the difficult task of reconstruction; but the loss is also felt outside Germany in a number of countries where Credner had won many friends, particularly in Sweden, Siam, China, and the United States. His untimely death came just after he had accepted the chair of geography at the University of Heidelberg, where he had received his Ph.D. in 1922 under Alfred Hettner, and at a moment when he was looking forward to new responsibility and a larger field of activity.

Professor Credner was born on December 23, 1892, in Greifswald. He belonged to a family that has produced a number of scientists. Six years of military service interrupted his academic training, first directed toward a career in mining. It was not until 1919 that he was able to resume his studies, this time in the field of geography. His early interest in mining is reflected in several excellent papers dealing with this industry. In 1925 he became *Privatdozent* at Kiel, after having completed his study "Landschaft und Wirtschaft in Schweden" (Breslau, 1926). This book had considerable influence on economic geographers in Germany because it developed a new geographical approach to the economy of a country through a study of the morphology and physiognomy of various economies such as hunting, fishing, reindeer nomadism, forestry, agriculture, and mining.

From 1927 to 1929, Credner traveled on the mainland of Southeast Asia (Burma Siam, Indochina, and Malaya) but devoted most of his time and energy to field studies in Siam. During the period from 1929 to 1931 he established and taught in the geography department of the Sun Yat-sen University in Canton. This stay in Canton and a trip in Yunnan familiarized him with South China, a former home of the Tai. The results of these

four years of travel and residence in Southeast Asia found their culmination in his book "Siam: Das Land der Tai" (Stuttgart, 1935). A reviewer writing in the *Geographical Review* (Vol. 27, 1937, pp. 518–519) called this book the most exhaustive and most authoritative work on Siam that had yet appeared, an evaluation that still holds true. German colleagues considered it, like his earlier book on Sweden, a landmark in geographical writing. His papers dealing with various aspects of the human, cultural, and economic geography of the mainland of Southeast Asia are numerous. Of special importance are "Völkerschichtung und Völkerbewegungen im mittleren Hinterindien" (*Geografiska Annaler*, Sven Hedin anniversary volume, 1935, pp. 268–284), the section on "Hinterindien" in Klute's "Handbuch der geographischen Wissenschaft" (volume on "Sudasien," 1937, pp. 327–452), and his last paper, "Kultbauten in der hinterindischen Landschaft" (*Erdkunde*, Vol. 1, 1947, pp. 48–61).

In the fall of 1938, Credner was Carl Schurz Memorial professor at the University of Wisconsin, and during the year 1938–1939 he lectured in several American universities and made the acquaintance of a number of American geographers. He traveled extensively in the United States, and also in the West Indies. A series of some ten papers, dealing mainly with agricultural geography, are the fruit of this visit to the New World.

A number of German and other European geographical societies honored Professor Credner with medals or by electing him to corresponding or honorary membership in recognition of his contribution to the development of the geographical discipline. His energy and his ability to organize were demonstrated on many occasions, most recently in preparation of the Deutsche Geographentag, which met in September, 1948, in Munich shortly before his death. Reports from those who attended the meetings and excursions testify that he showed there once more the characteristic marks of his personality: eloquence and lucidity, infectious enthusiasm, personal charm, and thoughtful consideration for his students and colleagues. Few excelled him in his devotion to the cause of geography, which was to him really *Herzenssache*. A bibliography of his writings has been prepared, and a copy is on file in the library of the American Geographical Society.—KARL J. PELZER

GEOGRAPHICAL NEWS

FOURTH PAN AMERICAN CONSULTATION ON CARTOGRAPHY. The Fourth Pan American Consultation on Cartography was an outstanding success. As readers of the *Review* will recall from the reports of previous Consultations, these inter-American official meetings on cartographic matters are sponsored by the Commission on Cartography of the Pan American Institute of Geography and History, in cooperation with the several national governments (on the Third Consultation, which was held in Venezuela in 1946, see the *Geogr. Rev.*, Vol. 37, 1947, pp. 121–128). The Government of the Argentine Republic was host to the Fourth Consultation, and technical discussion sessions and business meetings were held in Buenos Aires during the period October 14 to November 3 of last year; from November 4 to 14 the attending delegates were guests of the government on a geographic excursion that included the Andean lake region at Bariloche and the city and surroundings of Mendoza.

The Fourth Consultation was, in point of attendance of official delegates, advisers, and observers sent by American nations, the largest that has been held so far. The United States Delegation was composed of eight delegates, among whom was Mr. Charles B. Hitchcock, Assistant Director of the American Geographical Society; seven technical advisers,

and 14 observers from United States official agencies also attended. Twenty of the American republics were represented, and also Canada, and there were delegates from the International Civil Aviation Organization, the International Hydrographic Bureau, the International Council of Scientific Unions, the International Union of Geodesy and Geophysics, and the International Society of Photogrammetry. The American Geophysical Union, the American Congress on Surveying and Mapping, and the Inter American Statistical Institute also sent representatives. The total registration of persons attending from outside Argentina was 112, and 67 persons were accredited by the Argentine Government.

The technical sessions were conducted as open meetings of the various committees of the Commission on Cartography: the Committee on Geodesy, and the Sub-Committee on Gravity and Geomagnetism; Committee on Topography and Aerophotogrammetry; Committee on Aeronautical Charts; Committee on Hydrography, and Sub-Committee on Tides; Committee on Urban Surveys; and Committee on Special Maps and Charts. As a regular part of the preparation for the Consultation the National Member of the Commission in each of the American republics sent in reports on activities and progress in the various branches of cartography in his country for the period that had elapsed since the preceding Consultation. Emphasis in the technical discussion sessions was principally directed toward (1) improvements and necessary changes in specifications for the principal series of maps and charts; (2) improvement in technical methods and in equipment; (3) encouragement and increase of the habit of international cooperation in carrying out, across national boundaries, surveying operations basic to production of standard maps and charts.

Where all the branches of cartography were well represented, it was difficult to pick out any single subject as being outstanding. It should be recorded, however, that special interest attaches to three matters, principally because they are rather new in the operations of the Commission on Cartography. One, the Inter American Geodetic Survey, involves the cooperation of the United States and the other republics in the extension of first-order triangulation and levels throughout the Americas. This collaboration was proposed at the Third Consultation, in Venezuela in 1946. Most of the American nations have now entered into cooperative agreements with the United States and with each other, and remarkable progress has been made in establishing a main connecting chain of triangulation, which picks up the system now extending from Bering Strait through Alaska, Canada, the United States, and Mexico and carries it down into Central and South America. Reconnaissance has been completed as far south as Chile, and base measurement and measurement of angles are progressing rapidly. All the work done in any country is, of course, in accordance with specifications of the Commission, which are in proper agreement with those of the International Union of Geodesy and Geophysics. A substantial aid has been the manual on geodetic practice prepared by the Commission's Committee on Geodesy and distributed in preliminary form before the meeting at Buenos Aires.

Another much-discussed topic was seismology. There was considerable sentiment for establishing a committee in this field, and the governments of Mexico and Chile both offered to sponsor such a committee by providing quarters, facilities, and funds. Both nations proposed to establish a vigorous national geophysical institute, with seismology as a nucleus. Emphasis was also placed on oceanography, and this subject received for the first time a definite place on a Consultation program. At the Second Consultation, in Rio de Janeiro in 1944, a resolution was enacted urging the American governments to extend

hydrographic surveys farther out from the coast line. Such techniques as radioacoustic ranging and, more recently, electronic procedures such as shoran make it technically feasible to extend detailed surveys of the ocean floor out beyond the distance possible when ship location had to be determined by triangulation from points visible on the shore. The increasing appreciation of the importance of the sea and its resources indicates the advisability not only of extending hydrographic surveys out to greater distances but also of a program of fundamental study of the sea and its resources.

An exposition of cartographic progress has always been a feature of the Consultations. The exhibition of maps and charts at Buenos Aires was both larger and more comprehensive than heretofore, and a new emphasis was laid on the exhibition of instruments and equipment.

The Fifth Consultation on Cartography will be held in Santiago, Chile, in August-September, 1950. At that time the Institute will hold its General Assembly, including not only Consultations on Cartography but similar sessions of the Commission on History and the Commission on Geography.

All of those attending the Fourth Consultation were deeply appreciative of the hospitality of the Argentine Government. The Consultation was officially opened by General Juan Domingo Perón, President of the Republic, who, accompanied by Señora Perón, also opened the Exposition. The arrangement and management of the Consultation were admirably handled by General Otto H. Helbling, Argentine member on the Commission on Cartography, and Colonel Pedro Roberto Quiroga, Chairman of the Commission's Committee on Topographic Mapping and Aerophotogrammetry. These gentlemen, representing the Argentine Organizing Commission, provided excellent quarters for Consultation sessions in the fine new building of the Faculty of Law and Social Sciences and in general provided for the conduct of the Consultation in accordance with the tradition of Argentine hospitality.—ROBERT H. RANDALL, *Chairman of the Commission on Cartography and of the United States Delegation*

ANNUAL MEETINGS OF AMERICAN GEOGRAPHERS. The joint meetings of the Association of American Geographers and the American Society for Professional Geographers, held in Madison, Wis., December 27 to 30, 1948, marked the beginning of a new era; at a business meeting on December 29, as a result of an overwhelming vote by both memberships, the two societies were officially merged and the new, enlarged Association of American Geographers came into being. Pledged by its president to "retain all that is best in the heritage of both the former organizations" and "to delete whatever is unproductive in the heritage of each," the new association will be guided during its first year by the following officers: Richard Hartshorne, president; Shannon McCune, vice-president; Charles B. Hitchcock, treasurer; and Walter W. Ristow, secretary. Henry M. Kendall continues as editor of the *Annals*, and Shannon McCune becomes editor of *The Professional Geographer.*

The opening session on Monday afternoon included two papers on the work of geographers and three on geographical methodology: John Wesley Coulter spoke on "The Method of Science in Geography"; Preston James discussed "Formulating the Objectives of Geographic Research"; and George Beishlag was forthright on "What's Wrong with Geographic Writing?" Business meetings of both societies occupied Monday evening.

During the next two days and a half, ~~46~~ papers were presented in parallel sessions.

Eleven dealt with economic geography, six each with urban, historical, political, and regional geography, four with geomorphology, three with climate, three with the work of the United States Bureau of the Census, and one with vegetation. "The Geographical Seminar" was the subject of a symposium on Tuesday evening, at which papers by Isaiah Bowman ("Criticism and the Seminar"), Carl O. Sauer ("The Seminar as Exploration")—read by George F. Carter and Andrew H. Clark respectively—and J. Russell Smith ("The Seminar—Research and Presentation") were presented and discussed.

At the annual banquet, on Wednesday evening, Richard Hartshorne read a memorial to Ralph H. Brown, editor of the *Annals* from 1947 until his death in February of last year. The presidential address, "Geographical Geomorphology," was delivered by Richard Joel Russell, retiring president of the former AAG. Officers of the new organization were introduced, and Professor Hartshorne, the incoming president, gave a brief and graceful talk on the amalgamation and the aims of the new AAG.

Aside from the merger of the two societies, the Madison meetings were noteworthy in several other respects. A departure from established custom was the circulation in advance of copies of the papers to be presented among individuals expressing willingness to read and comment on them. Critical discussion of each paper was thus stimulated. A second novel feature was the showing of motion pictures (see below). Finally—welcome news to geographical wives—the 1948 sessions were perhaps the swan song of Christmas-holiday meetings; by decision of the new Council, the annual meeting will henceforth be held in the spring. In April, 1950, Clark University will be host to the Association at Worcester.

The presentation of motion pictures of geographical interest proved to be a successful innovation. Showing was continuous from 8 a. m. to 6 p. m. on December 28 and 29. Of the 26 films, eight were supplied by the University of Wisconsin Bureau of Visual Instruction (through the Department of Geography), which also provided operators, two projectors, and other equipment. The rest of the films were lent by various domestic and foreign government agencies, industrial concerns, film companies, universities, and private persons. Answers to a questionnaire showed entire approval of the project, and it is hoped that it will be continued and developed at subsequent meetings. "Audience reaction" rated as the top four films "Latitude and Longitude," produced by Gaumont British Instructional Films with the collaboration of the Royal Geographical Society; "Exercise Musk-Ox," produced by the National Film Board of Canada for the Department of National Defence; "The Impossible Map" (representing the world accurately on a flat surface), produced by the National Film Board of Canada; "Graduate Field Training in Geography," produced by Fred Dohrs and the Department of Geography, Northwestern University. In addition, there were special evening showings of "The Secret Land," a 72-minute popular color version of the United States Navy Expedition to the Antarctic, made available by the Navy with the permission of Metro-Goldwyn-Mayer. Further information on the program can be obtained from Lloyd D. Black, 9111 Wire Avenue, Silver Spring, Md., who, with A. K. Botts was responsible for its organization.

GEOLOGY AND WATER RESOURCES OF PALESTINE. By G. S. BLAKE and M. J. GOLDSCHMIDT. iii, 413, 12, and xxxix pp.; ills., bibliogr., indexes; with separate folder containing 31 maps and sections. Department of Land Settlement and Water Commissioner (obtainable from the Government Printer), Jerusalem, 1947. £P. 1.800 (cloth, £P. 2). 9¼ x 6¾ inches.

This book expands tenfold Mr. Blake's original one-map work of the same title published in 1928. The new study utilizes hydrological surveys made between 1934 and 1938, including previously unpublished material on the Negeb and the southern Ghor gathered by Mr. Blake, who was killed by Arabs in 1940 while on a field trip. Considerable published material also was available, particularly the studies issued by the Geological Department of the Hebrew University, Jerusalem (cf. Leo Picard: Groundwater in Palestine, 1940). The result is a valuable compendium of information on ground water and its accessibility through wells and springs. Stream water is not covered.

Geology and regional hydrogeology are discussed separately for northern, central, and southern Palestine. Detailed well logs provide the basis for 19 hydrogeological cross sections of the coastal plain and the neighboring uplands, showing the ground-water levels as of 1934. The thorough description of the water bodies and their sources could be followed more easily if an adequate location map or maps had been provided showing the 23 areas and numerous subareas. An awareness of this lack is suggested by mention in the table of contents of the map folder that a geological map of Palestine can be obtained from the Director of Land Settlement and Water Commissioner at Jerusalem, so far as the limited number of copies permits. The study does include geological and hydrological sketch maps of southern Palestine (1 : 250,000) and the southern Jordan Valley (1 : 100,000) and a copy of the general rainfall map (1 : 500,000) issued in 1946.

The authors classify the underground waters of Palestine in two main groups: the waters in permeable rocks of the upland, and those in the sediments of the principal plains. The plains waters have been intensively surveyed, especially in the coastal plains and the Plain of Esdraelon, the chief sites of recent Jewish settlement. In these western plains impervious beds of clay normally separate the water-bearing Pliocene and Pleistocene sand and sandstone from underlying rock strata, also water-bearing, that dip below the plains from the uplands. The great stores of water in the sands and sandstones of the coastal plains are the chief source of the irrigation water that has justly been called the *Bodenschatz* of Palestine. A special body of high-quality water of local origin is contained in the coastal dune belt, about three kilometers wide in the Haifa-Acre Plain.

In the plateaus of Galilee, Samaria, and Judea the dolomite and dolomitic limestone of Middle and Upper Cretaceous age are the principal aquifers. Most of the wells and springs of Biblical fame derive from these porous formations. The Middle Cretaceous is particularly noteworthy for its large springs and wells, though in some districts they dry up during the summer. Upper Cretaceous springs are smaller but more dependable throughout the year.

Annual discharge rates are given for the springs, and flow rates and drawdowns for the wells, but no attempt is made to synthesize individual flow or pumping estimates into broad generalizations of water availability or adequacy. There are isolated notes on water use.

In many of the wells of the western plains the water level has fallen as a result of use for irrigation. In many wells falling water level has ended in stabilization at a lower level; in a few the fall has been great enough to cause abandonment of the well. On the other hand, most of the abundant water of the large springs in the dolomitic outcrops of the escarpment west of the Dead Sea is unused, though the local Beduins do a small amount of irrigating. In this vicinity there are traces of old terraces, suspected by the authors of having been used for vineyards referred to in ancient Jewish writings. Farther north along the escarpment considerable reserves of water are available if tapped by drilled wells.

The geographer wishes the facts had been summarized. Boldface headings and running heads would have made it easier to locate sought-after material, and the dictionary might well have been consulted more frequently. But the encyclopedic value of the study is unquestionable.—PEVERIL MEIGS

LE LIMES DE CHALCIS: Organisation de la steppe en Haute Syrie romaine. By R. MOUTERDE and A. POIDEBARD. In 2 vols.: text (xvi and 254 pp.; maps, ills., bibliogr., index) and atlas (plates, map, plans). (Délégation Générale de la France au Levant, Mission Archéologique Permanente, Bibliothèque Archéologique et Historique, Vol. 38.) Librairie Orientaliste Paul Geuthner, Paris, 1945. 11¾ x 9 inches.

Père Poidebard's "La trace de Rome dans le désert de Syrie" (1934) demonstrated the value of air photography as an instrument in the service of the archeologist; with its help a survey of the Roman frontier in the Syrian desert was carried out, and the next few years saw similar work in the Roman frontier regions of North Africa by Averseng and Leschi and in Transjordan and Iraq by Sir Aurel Stein. Now, after fifteen years' collaboration, Père Poidebard and Père Mouterde have produced a companion work to "La trace de Rome," in which the results of air survey and work on the ground have been collated to give a comprehensive picture of the Roman frontier region in the steppes south and east of Antioch.

In "La trace de Rome" the advanced fortifications were examined. In "Le limes de Chalcis" the coauthors set out to discover whether the Romans left undefended the open steppes within the outer lines. Air-ground research showed that the whole region between the Euphrates and the Orontes was provided with a network of roads linking natural obstacles with fortified towns, observation and guard posts, forts, water-supply points, and irrigated, fortified oases. This system of defense in depth pivoted on Chalcis, situated where the main road from Antioch to the east crossed the great route coming up from Damascus and the south.

This steppe region was no barren glacis; its natural resources were exploited to the full. All over the region, the greater part of which today either is uncultivated grazing country or is devoted to poor dry farming, there are the ruins of villages, amply provided with cisterns, wells, and irrigation canals. Some hillsides were terraced for the cultivation of grain, vines, and fruit trees. The artificial oases were engineering tours de force and must have appeared miracles of fertility and luxury in an arid country. S. Mazloum, in a fascinating note on Qdeym, one of these oases whose irrigation works have recently been partly renovated by a Bedouin sheik, describes how Roman hydraulic engineering created 250 hectares of irrigated land in a dominantly pastoral country, to support a village or urban population among whose pleasures were probably aquatic displays in the open fresh-water reservoir.

The authors add their authoritative voices to the body of informed opinion which insists that the post-Roman decline of the region was not due to climatic change. In Roman times great care and ingenuity were devoted to the collection and conservation of water. Père Charles Combier, in his note on the accompanying rainfall map, shows that over the whole region large supplies of water can be made available if conservation methods are employed. Today some of the Roman irrigation works are being renovated and irrigation is being extended by new works. The fruitful utilization of such an area is made possible by work and security, and its decline was due, not to climatic change, but to war, anarchy, and administrative and economic decay.

Many smaller points are cleared up. For example, it is firmly established that the ancient Occaraba was on the site of the present village of Aquerbat, not on that of Aquareb—a point over which a surprising amount of ink has been spilled.

One of several regional descriptions, with its map, is of the interesting Jebel Isriya, near the ancient Seriane, an important road center in the steppes. This hilly area was just within the limits of the Palmyrene state, and the authors believe it to have been devoted to carefully regulated stock raising, like the near-by Jebel Sha 'ir examined by Schlumberger, a conclusion the reviewer had reached independently. The famous horses and camels of Palmyra probably grazed here, and the authors might have added that today "the best horses in Arabia" are bred by the Sbaa tribe on these famous pastures.

Volume 2 is entirely devoted to plates, a map, and plans and is of the same standard of excellence as the text. The whole work is of great value, hardly less to the historian and the geographer than to the archeologist. Here indeed is brilliant and authoritative historical geography—though that long-suffering term is not once used.—NORMAN N. LEWIS

LAND AND POVERTY IN THE MIDDLE EAST. By DOREEN WARRINER. vii and 149 pp.; maps, bibliogr., index. *Royal Inst. of Internatl. Affairs Middle East Econ. and Social Studies* [*No. 1*], London and New York, 1948. 7s. 6d. 8½ x 5½ inches.

"Near starvation, pestilence, high death rates, soil erosion, economic exploitation—this is the pattern of life for the mass of the rural population in the Middle East. It is a poverty which has no parallel in Europe, since even clean water is a luxury." Anyone familiar with the region knows that there is much truth in Miss Warriner's introduction to her informative little book, yet the picture is probably not as dismal as the quoted statement would seem to indicate. Because people do not have the plumbing, the sanitation, and the techniques of the modern world, it does not necessarily follow that they do not live satisfying and happy lives. On a first visit to the Orient the Westerner is likely to be shocked by the physical conditions he finds, but on becoming better acquainted with the inner lives of the people he is likely to discover values that help to compensate for the lack of motorcars, banks, and farm machinery.

The book is packed with interesting facts about the land, the population, and the problems of rural life in Egypt, Palestine, Transjordan, Syria, the Lebanon, and Iraq. Each of these countries is treated separately and its chief economic and social problems considered. Land tenure is shown to be one of the critical sources of trouble in most of the countries of the Arab world. In the delta of Egypt, where the pressure on land is probably more acute than in any other part of the world, the problem is entirely different from that in the Jezira in Syria, where millions of acres of fertile soil lie ready for reclamation by irrigation. Unlike

as the two areas are, they have a great deal in common, because in both the code of the Koran has had much to do with the rules for management and ownership of the land. The discussion on Palestine naturally concerns itself largely with a comparison of the Arab and Jewish populations. In 1922 the Jewish population was only 83,790, the non-Jewish 668,258; by 1946 the Jews numbered 608,230 and the non-Jews 1,303,883. In other words, the non-Jewish population had approximately doubled, whereas the Jewish population had increased almost eight times. This development gives the key to much of the trouble which now plagues that unhappy land.

The two final chapters are devoted to "The Need for New Forms of Tenure" and "The Need for Agricultural Planning." These chapters give an excellent summary of the situation as a whole. They reveal something of the new factor that has come into the problem as a result of the large oil developments in several sections of the Middle East.

The more than 40 titles in the bibliography show that much has been published in recent years on land problems in the Middle East, which is certainly one of the critical parts of the world from the standpoint of economics and sociology as well as of world peace. The present publication is a helpful addition to the literature.—FRANKLIN S. HARRIS

L'EXPÉRIENCE SIONISTE. By GEORGES REUTT. 231 pp.; maps, ills., bibliogr. Imprimerie Ch. Riveill, Algiers, 1948. 350 frs. 10 x 6½ inches.

Dr. Reutt is an engineer in the agricultural service of Algeria, who in 1945 had an opportunity to visit Palestine. His preparation for writing this treatise is explained in the preface by Professor R. Capot-Rey. His book is divided into three parts. The first discusses the conditions of the development of agriculture in Palestine; the second tells of the Zionist colonization; the third summarizes the new social forms and the reasons for the success of certain projects. About twenty pages are devoted to appendix material.

In the opening chapter, dealing with the environment, Dr. Reutt points out the great variation in topography, soil, and resources in this comparatively small area; he includes also a section on the state of agriculture at the beginning of the century. The chapter devoted to the population is one of the most interesting. Tables bring out the great comparative increase in the Jewish population during the past 25 years (see above). The political aspects are next discussed—the Arab and Jewish communities, the political and other organizations formed by both Arabs and Jews for protection and welfare.

In the chapter on the factors affecting land utilization the importance of water is emphasized. A consideration of the recent expansion in production follows. Among the tables is one showing gains between 1938 and 1944. For fruits and some field crops the increase amounted to about 500 per cent; for dairy products from 28 to 95 per cent. Jewish and Arab acreage and production are compared, and the fruit plantations of Palestine and Algeria.

About half of the book is devoted to a discussion of the various phases of the Zionist colonization. A number of projects and communities are discussed in detail, and the reasons for success or failure are analyzed.

On the whole, Dr. Reutt's book may be described as informative rather than controversial. Those of us who have visited Palestine and who have read recent literature on the present situation have been impressed by the enormous gap between the points of view of Arab and Jewish protagonists. It is refreshing to find a discussion of the subject that is not obviously partisan.—FRANKLIN S. HARRIS

MEN, CITIES AND TRANSPORTATION: A Study in New England History, 1820–1900. By EDWARD CHASE KIRKLAND. Vol. 1, xvi and 528 pp.; Vol. 2, ix and 499 pp.; maps, ills., index. (Studies in Economic History, published in cooperation with the Committee on Research in Economic History, Social Science Research Council.) Harvard University Press, Cambridge, Mass., 1948. $12.50. 9½ x 6 inches.

The period of eight decades during which the railroad was born, developed, and became the mainstay of New England is the subject of this excellent and comprehensive work, which, in the words of the author, seeks "to treat the New England transportation system as a human response to the changing needs and ambitions of that area." That these needs and ambitions clearly reflect not only the rapid changes in technology in the nineteenth century but also the relationships of that technology to the natural environment and the interregional relationships of New England is amply demonstrated by the pattern of the railroad network. The struggle of Boston, handicapped by a peripheral location and topographic barriers, for the trade of the West in competition with New York and the other North Atlantic seaports is a dominant theme of the book.

New England, for purposes of this history, extends to the Hudson River and Lake Champlain, and the histories of water and rail transportation to, across, and upon those waterways are considered as a part of the transportation history of New England. "Every proper New Englander knows that the twenty mile strip between the Hudson and the nominal western boundaries of the New England states really belongs to New England." The author's introductory comparison of the physical geography of New England with that of the United States as a whole is questionable; the comparison is refuted by much of what follows. The United States is a major part of a continental mass; New England is physically, and to some extent economically, a peripheral area. During the period covered by this book it lost out relative to the more rapidly growing areas to the west and southwest; nevertheless, its efforts to tie itself to the rest of the country were gigantic as regards the capital expended, as in the construction of the Western (Boston and Albany) and the Boston and Maine railroads over the Berkshires.

The book opens with a description of the early maritime trade and goes on to deal adequately with the canals, roads, and turnpikes of the prerailroad era. One wishes, however, that the highways and their traffic, and the canals also, had been treated in more detail in relation to the effects of the railroads on their patterns of traffic during the later years of the century. The geography of the coastal shipping of New England is clearly developed in several chapters that form a noteworthy addition to the literature on maritime New England, comparable in careful scholarship and colorful prose with some of the works of Morison and Albion. The chapters treating of the economic struggles and the technical aspects of the Long Island Sound steamboat lines are especially noteworthy. The effects of the Cape Cod barrier in separating the trade areas of Boston and New York are evidenced by the pattern of evolution of the coastal shipping trades, both before and during the steamboat period, and even in the latter years of the century when the railroads became dominant.

As the title implies, much attention is given to the human element, for which the author has a warm feeling. The role of government in financing, and later in regulating, transportation improvements and operations also is given due consideration.

"Men, Cities and Transportation" is a comprehensive, scholarly, and interestingly written account of the evolution of transportation in New England during the period of

its major industrialization: the period that saw a large number of small, disconnected transportation enterprises grow in number and then consolidate into two major railroad systems and one large steamboat monopoly, the latter no longer in existence. To the geographer, the work is of especial interest, because, more than most historians, the author recognizes throughout the importance of the environment in which the evolution took place.

Several small maps trace the expansion of the railroad pattern. Unfortunately, they show merely the locations of the terminals and junctions and the general directions of the routes; they would have been more significant had they shown also something of the terrain. There is a thorough documentation by footnotes, but the sources have not been listed in a bibliography.—HAROLD M. MAYER

THE LOCATION OF ECONOMIC ACTIVITY. By EDGAR M. HOOVER. xv and 310 pp.; maps, diagrs., bibliogr., index. (Economics Handbook Series.) McGraw-Hill Book Co., New York, Toronto, London, 1948. $3.75. 9¼ x 6 inches.

The author is probably best known to geographers for his more limited work entitled "Location Theory and the Shoe and Leather Industries," published in 1937. In the present book he gives a comprehensive view of locational matters. Starting with the considerations influencing individuals in locating businesses, he proceeds to the uses of rural and urban land and the problems of changes in locations and ends with public policy as related to areal economic conditions. The descriptive aspects of economic geography are purposely kept to a minimum in order to cover the governing principles as fully as practicable.

One of the main conclusions to be drawn from Hoover's analysis is that it is virtually impossible to equate quantitatively the numerous forces that tend to localize economic phenomena. This, from an economist, may perhaps be consolation for the economic geographers who at times feel chagrin at their inability to present an explanation, for example, of the localization of the iron and steel industry, or the farm-implement industry, in a nice tight package. An excellent case is made for the importance of locational knowledge. More and more, conscious attention is being given to location as a problem per se, not only by individual entrepreneurs and wage earners, but also by all the many units of government.
—CLARENCE L. VINGE

PHYSIOGRAPHY OF THE CANADIAN CORDILLERA, WITH SPECIAL REFERENCE TO THE AREA NORTH OF THE FIFTY-FIFTH PARALLEL. By H. S. BOSTOCK. ix and 106 pp.; map, ills., index. *Canada Geol. Survey Memoir 247*, 1948. 25 cents. 9¾ x 6½ inches.

This memoir is the result of several years' effort by a geologist whose knowledge and field experience of the northern Canadian Cordillera are, in the opinion of many, unparalleled. The painstaking care with which the material was assembled and the detailed examination of thousands of air photographs impressed those who had an opportunity to see the work in progress.

Bostock's systematic account breaks new ground; for large parts of the region he discusses were almost unknown, despite the existence of earlier descriptive accounts. Most of these older works necessarily emphasized the much better known southern part of the Canadian Cordillera. In the new publication we have a systematic pattern and outline plus valuable descriptions of individual physiographic units.

The core of the memoir is the map (available separately as Map 922A of the Geological Survey of Canada), published in colors on the scale of 40 miles to the inch (1:2,534,400). Basically geomorphic, the map also includes lithologic information. Thus the six colors represent: intermontane plains, valleys, and basins; foothills and plateaus of sedimentary rocks; plateaus containing intrusive rocks; mountains of sedimentary rocks; mountains containing intrusive rocks; and mountains largely composed of intrusive rocks. For the purpose this seems an excellent arrangement.

As on the United States Geological Survey's widely used map of the physical divisions of the United States, the relative importance of the natural features is indicated. The main divisions and subdivisions are shown on a chart printed on the map sheet.

In the main, the nomenclature adopted by the Geographic Board of Canada in 1918 is used. The chief regions, following the grain of the regional topography as a reflection of the geologic structure, are the Eastern System, the Interior System, and the Western System. Very roughly these correspond, respectively, with the widely known Rocky Mountains, Interior Plateaus, and Coast Mountains, but actually, as Bostock's study shows, they are more complex. Divisions are carried down to the sixth order; these smallest units consist principally of individual mountain ranges.

An extremely useful feature of the map is that it shows the western limit of the glaciers of the latest Pleistocene glacial stage. This information, in an earlier version, was supplied by Dr. Bostock for incorporation in the "Glacial Map of North America" published in 1945 by the Geological Society of America.

The text amplifies and explains the map. It contains a wealth of information, much of it wholly new, and is illustrated with many air photographs that help to create a clear understanding of the terrain. The memoir is sure to be a basic reference on the Canadian Cordillera for a long time to come.—RICHARD FOSTER FLINT

THE GRASSLANDS OF LATIN AMERICA. By G. M. ROSEVEARE. 291 pp.; maps, ills., bibliogr., indexes. *Imperial* [now *Commonwealth*] *Bur. of Pastures and Field Crops Bull. 36,* Aberystwyth, Great Britain, 1948. 20s. 9¾ x 7¼ inches.

This substantial book is a review of existing information on the grasslands of Latin America with respect to stock raising. Summaries of this nature, though contributing nothing new, are always of value and are necessary from time to time, most especially for a region where scientific information is usually fragmentary, incomplete, conflicting, and dispersed in numerous diverse and often scarce or obscure publications in many languages and of varied scientific standing (in this bulletin there are more than 850 citations of literature in eight languages). Miss Roseveare's thoroughgoing work will be heartily welcomed and will doubtless become a standard reference.

The natural grasslands of Latin America are classified into four types: good natural grasslands (the pampas of the subtropical and temperate south), cool mountain grasslands, semiarid grazings, and savannas of hot climates. For each of these types there is a general geophysical description of the region, its extent, climate, and soils. In more detail, botanical and ecological data are given on the plant cover, both primitive and as modified by man, and on its value as forage. The development and present state of animal industry are outlined, and cultural practices and methods of management are described. Professor L. R. Parodi of Buenos Aires contributes a chapter on natural grazings in the Province of Co-

rrientes, Argentina, and stock raising in the Argentine Chaco. The book concludes with chapters on temporary ley; browse plants and poisonous and undesirable plants; erosion, grassland, and soil conservation; animal and plant health; management and improvement; botanical research; and, finally, the present state of cooperation between countries, research, and government action. Besides the references, there are indexes of authors and of genera and species.

As the work is a compilation, no personal views are expressed. Where authors disagree, the reader is left to form his own conclusions. We are told in the foreword that it is the policy of the issuing bureau to present summarized information in this form. The quantity of information given here varies considerably, according to the literature available for the different types of grassland. It is naturally greatest for the "good natural grasslands" of the south, which are the most valuable economically, have been most developed, and carry the heaviest population. In contrast, the information on the savannas of hot climates is meager; the treatment of the soil, for example, is inadequate, because there is virtually nothing in the literature about it. Works such as this serve only too well to show how little we still know of many matters in this dark continent.

One point seems to call for comment. Among the savannas of hot climates, the Bolívar savannas of Colombia and the lowland savannas of Costa Rica are described as unique in that they provide good pasture and have been developed as breeding grounds for stock. The reason is that they are composed of artificially propagated grasses of good nutritive value, and the deduction Miss Roseveare makes is that it should be possible, by propagating such grasses, to improve poor natural savannas elsewhere. It is necessary, however, to stress that the natural savanna of tropical America is a product of soil conditions too adverse for the growth of trees, crops, or even grasses of nutritive value, and it is extremely doubtful whether it can ever be artificially improved. The success of the grazing lands in Colombia and Costa Rica is due to the fact that they have been established on what were naturally forest soils. Tropical America holds abundant examples of good pastures artificially established on former forest soils, but there is a vast difference between them and the natural savannas.—J. S. Beard

PROSPECTS FOR SETTLEMENT IN NORTHEASTERN NEW GUINEA. By Robert G. Bowman. 127 pp.; maps, diagr., ills. *State Univ. of Iowa Studies in Nat. Hist.*, Vol. 19, No. 1, 1948. $1.00. 9¼ x 6¼ inches.

This study, made for the Refugee Economic Corporation of New York, is based on the author's wartime experiences in the Southwest Pacific, including an extended stay in New Guinea, on conversations and correspondence with knowledgeable persons, and on the available, but scanty, literature. The broad conclusion is that further investigation is worth while. Two areas seem to hold out definite possibilities for white settlement, one at the head of the Gulf of Papua, the other the structural valley running northwest from the Huon Gulf. It is the latter that is discussed. The area of this Markham-Ramu Valley region suitable for agriculture is put at about 1000 square miles, enough to support, say, 60,000 persons. Variation is the keynote of the region; hence the need for "micro" studies. Climate in the lowlands is hot and humid, but even here exact siting is important, especially in relation to the vivifying breeze. The contiguity of highlands holds the "master key" to successful implanting of Europeans; although there is not sufficient land for white farms on the plateau,

rest and recreation camps could be established. Some of the alluvial soils of the valleys seem to be unusually well endowed, but here again there is marked variation from locality to locality, and, as with all tropical soils, maintenance of fertility will pose a problem. Wartime production was gratifying, but this was on virgin ground (cf. R. G. Bowman: Army Farms and Agricultural Development in the Southwest Pacific, *Geogr. Rev.*, Vol. 36, 1946, pp. 420–446). The range of subsistence and commercial crops that can be grown is enormous, but besides soil-fertility questions, methods and markets enter into the picture. Transportation must be considered: two good ports exist in Lae and Finschhafen, and a good road was built in 1944 up the Markham Valley to Nadzab; but construction and maintenance of roads present difficulties in the interior, and air service is often handicapped by the weather over the ranges. Possibilities of employing local native labor are slight; mechanization of agriculture offers most hope. Malaria, scrub typhus, dengue fever, and skin infections are the most serious diseases likely to be encountered. Much depends on proper housing and clothing, and here reference is made to the work of Douglas H. K. Lee. Attention must be paid to psychological attitudes on the part of settlers.

All these considerations mean that further investigation calls for a team composed of at least a civil engineer, a medical officer, a plant ecologist, a geologist, a soil scientist, and an agricultural economist. It is suggested that, if their conclusions should be favorable, a trial settlement of 50 to 100 families be established in the vicinity of Nadzab, with agricultural experimental stations elsewhere.

Appendixes include lists of subsistence crops recommended and possible cash crops. There are two maps, one of the morphological regions of New Guinea reproduced from the *Geographical Review*, the other a larger-scale map of the Markham-Ramu Valley area. The photographs also include several reproduced from the *Geographical Review*. A condensed version of the report appeared in the *New Zealand Geographer*, April, 1948.

THE MURRAY VALLEY: A Geographical Reconnaissance of the Murray Valley and a New Design for Its Regional Organization. By J. MACDONALD HOLMES. xv and 280 pp.; maps, diagrs., ills., bibliogr., index. Angus & Robertson, Sydney and London, 1948. 30s. 9¾ x 6¼ inches.

This is the story of a river and its vast, loosely peopled drainage basin, a discriminating assay of human failures and gains along the waterway, and a revealing discussion of many varied problems, geographical, political, economic, and social, that require further detailed investigation and eventual solution before the full destiny of the river can be realized. Readers will not agree with all Professor Holmes's interpretations, opinions, and suggestions; but unquestionably he has done his country a service by spotlighting obstacles in the path of integrated planning and development for the "Father of Australian Waters." Knowledge should precede action in extending control over the waters of the Murray if past mistakes such as have led to salt accumulation in the soil, destruction of bank-protecting red gums, channel closing, excessive evaporation, and inadequate water storage are not to be repeated. The counsel of Australia's best scientific talent in every field related to land planning will be needed if a valley the size of the Murray, with its innumerable ramifications and conflicting interests, is to be fully developed in an orderly, harmonious manner. That is perhaps the outstanding impression this reviewer received during his personal inspection of the piecemeal developments along the Murray in 1941.

Much water from the Murray currently goes to waste through evaporation from ditches, canals, and storage ponds, through seepage, or through carelessness, in addition to that which moves directly to the sea during flood season. The discharge from the main Mulwala Canal, we are told, is sufficient to supply annually 12 cities each the size of Sydney if effectively applied! Conservation of existing water supplies is fully as important as expansion of storage facilities. Yet another great need is a more equitable distribution of social amenities between states where the river functions as a boundary. State-organized development of the valley has led to serious inequalities in the availability of domestic water supply, sewerage, electric light, schools, and hospitals, to the detriment of balanced development and harmony along both sides of the river.

Criticisms of a book with such scope and detail are inevitable. Professor Holmes uses the Köppen climatic classification to aid in identifying and characterizing his six major regions, though agricultural scientists at the Waite Agricultural Research Institute in Adelaide have for 10 years stressed the need for using in Australia a climatic classification that includes evaporation as an essential ingredient, such as Thornthwaite's. The statement (p. 138) that a region should not be too large for its people "to be of one mind on vital issues, especially in regard to local patriotism and local administration" sounds like a plea for one-party government. Professor Holmes asserts (p. 250) that "the average intelligence of people in the regions along the Murray Valley is higher than [in] similar sized regions elsewhere in Australia . . . and arises from the circumstance of irrigation farming, etc., which has to be more scientific than wool or wheat farming or even metropolitan factory work," but he offers no supporting evidence for so debatable a statement. He writes (p. 193): "A fully controlled waterway removes an anxiety common to all parts of Australia, namely unreliable and insufficient rainfall." Yet earlier (p. 141) he had remarked that the "lower country" of Region One (of the six regions into which the basin is divided) has a "reliable" rainfall.

Professor Holmes is to be congratulated for envisioning the integrated planning of the Murray Valley as a peculiarly Australian problem, rather than as a sort of glorified transplanted TVA enterprise. Planning for the Murray is an altogether different sort of proposition from planning for the Tennessee.—ROBERT G. BOWMAN

ENGLISH PLACE-NAMES. By H. G. STOKES. viii and 120 pp.; maps, ills., bibliogr., index. B. T. Batsford Ltd., London, New York, Toronto, Sydney, 1948. $3.75. 8¾ x 5½ inches.

PLACE NAMES OF THE DEATH VALLEY REGION IN CALIFORNIA AND NEVADA. Edited by T. S. PALMER. 80 pp. 1948. 9 x 6 inches.

BIBLIOGRAPHY OF PLACE NAME LITERATURE: UNITED STATES, CANADA, ALASKA, AND NEWFOUNDLAND. By RICHARD B. SEALOCK and PAULINE A. SEELY. x and 331 pp.; index. American Library Association, Chicago, 1948. $4.50. 9 x 6 inches.

The titles of some of Mr. Stokes's chapters suggest the variety of sources of English place names—"A Land of Woods and Water," "Early Landmarks," "Men and Manners," "Creatures Great and Small," "Legends and Words," "Up and Down the City Streets." This attractive book, illustrated with reproductions of old maps and photographs, serves as an excellent introduction to a fascinating subject. Not designed primarily as a reference book,

it nevertheless provides a wealth of information, and the brief bibliography will lead the reader to the important works in the field should he care to pursue the subject more intensively. From the odd and amusing names mentioned, a poet could compose a work similar in scope to Stephen Vincent Benét's "American Names" (*Life*, Jan. 31, 1944, p. 48). One pleasing example, from the many names showing a Continental derivation, is "Pity Me," which probably comes from "Petit Mer," the name of a small lake near which some French monks settled. Any prospective traveler to England could increase his enjoyment by perusing this book, and in the last chapter, "On Taking a Hand," and through the glossary, the author shows how stay-at-homes can also indulge in what he terms "a delightful leisurely hobby."

From British names, which go back into antiquity, we turn to Death Valley, which was discovered just one hundred years ago, though the name did not appear in print until 1861. Dr. Theodore S. Palmer, a member of the Biological Survey Expedition of the United States Department of Agriculture in 1891, has compiled a comprehensive list of about 570 place names, with the cooperation of the National Park Service. In contrast with other parts of California, only about 5 per cent of the names are of Spanish and Indian origin. The English names, often picturesque, are usually descriptive, botanical, faunal, personal, or historical; some reflect mining interests and tragedies related to early exploration. In a dictionary arrangement, the name, exact location, description, and origin are given, and also the first place of publication of the name, and the earliest map on which it appeared.

In the field of librarianship the word "service" is often used, and two members of the profession have performed a signal service by the compilation of a bibliography of North American place-name literature. Although it is practically impossible to produce an exhaustive list of references, this comprehensive work by Miss Seely and Mr. Sealock will place scholars in their debt. It is especially valuable because no adequate dictionaries of United States and Canadian place names exist and fewer than a dozen states have extensive guides to the origins of the names within their boundaries. The arrangement—after sections on the United States in general—is alphabetical by state, with special sections on New England and the Mississippi Valley; Canada follows a similar arrangement by provinces. New York State leads with more than a hundred references, but it is interesting to note that some of our newer states such as California, Washington, and Missouri have produced a large volume of literature. In addition to books, gazetteers, and periodical articles, the compilers have included some manuscript materials available in libraries and historical societies. Items in newspapers are noted and may to some extent account for the large number of references under New York—the *New York Times* is frequently cited. Annotations and a carefully prepared and detailed index greatly increase the value of the book. For all students undertaking place-name studies this bibliography will be a solid foundation on which to build.

The Geographical Review

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The Willing Ear

Questions, QUESTIONS, QUESTIONS!! Where do they all come from? The jangling telephone, the burdened postman, the embarrassed stranger at the door. "Where is this?" "What is that?" "Can you tell us . . . ?" A learned society, particularly a geographical society, is in the position of a harassed parent seated at an endlessly long table of inquisitive children, all popping questions at once.

Do you have information on large modern wall maps of the principal countries of Asia? No, for nothing very good has come out since the Haack maps were made in Germany in 1912. — *Do you have early maps of South America, showing the places mentioned in the career of Simón Bolívar?* Yes, the prized map carried by Von Humboldt during his explorations in South America hangs on our wall, and . . . — *Are there any snow-capped mountains on the equator?* Yes, that famous line cuts across the slopes of Kenya in Africa and almost nicks the summits of Cayambe and Sara Urcu in Ecuador.

From a great scientist who has appeared several times on "Information Please" (with tongue in cheek): *What mountain nearest New York City is higher than the Alps? What spot on the earth receives the greatest amount of solar radiation? Over what city would you pass on a direct flight from New York to Casablanca?* These we swallowed and tried for. But what to do with a former governor of Michigan who wrote to ask what was wrong with the Census Bureau that it assigned his state to sixteenth position in size when by his own calculation it stood sixth? Or the schoolboy who wanted to know the exact area of the whole of the United States? To these, no firm answer could be given, because in part the boundaries lie in water, and are you a politician or don't you like getting your feet wet? Or try to reply to the lady anthropologist who asks to be shown how to measure the area of a squirrel's denture!

Who uses the consulting services? A very wide range of people and organizations—fellow learned societies and museums, and government agencies, federal, state, and city; scientists, artists, teachers, and plain John Doe. Insurance firms come with questions of geographical-legal bearing,

shipping companies with transportation problems, advertising firms for needed statistics. Newspapers want quick decisions on current events; magazine and book publishers and university presses need material; students bring their theses; and the most frequent consultant of all is the United Nations.

Sometimes the questioners are even more interesting than their questions. — The President of the United States of the First World War dispatches his Secretary of State for an inquiry about maps for the peace conference to follow the war and later comes himself to the source of the information. — The President of the United States of the Second World War detaches a university head from his job to superintend our staff personally in answering his questions regarding Greenland, with 36 hours in which to produce the answers! — A famous character actor comes to the Society for technical instruction on sixteenth-century astrolabes. — An artist commissioned to illustrate a book of Ser Marco Polo wants us to identify the ancient place names on modern maps. — A mural painter requests us to pick out a projection to fit a giant map on a particular wall. — A marine painter wants us to find him the ideal coast: "rocky with deep water inshore, gales of force 8 or more, prevailing winds with a fetch of at least 600 miles over the ocean" —and preferably not too inaccessible. At last report our inquirer is considering Barra Island in the Outer Hebrides and Achill Island off northwestern Ireland. If our readers have any further suggestions, they would be gratefully received.

The *purposes* of the questioners merit scrutiny and, on occasion, deserve our refusal to comply. Most, however, have legitimate aims, though they do not necessarily serve the interests of science. An air-line company asks us to prepare a map showing especially how much longer the route of a competitor is, and The Port of New York Authority, in a related situation, wants a map that proves the superiority of New York as the entrance airport of the United States. A stamp collector needs a Chinese gazetteer to use in identifying the items in a collection of postmarks; the Immigration Service cannot release a man who says he comes from "X" in Bulgaria until the existence of that place has been confirmed. The radio and newspaper commentators and columnists buzz up to check their references, and the Answer Man is a steady consultant.

Sometimes we hesitate, wondering if the question is worth a reply. Fortune hunters are forever testing leads to buried treasure; "expeditions" are formed with no place to go; an engineer has the idea that Coney Island can be made into a second Palm Beach by changing the course of the Gulf Stream; crossword-puzzle fans fall upon us to supply a river in Asia with four letters, or a mountain in Australia with three; or we may learn that our opinion has been sought merely to settle a bet!

How long does it take to answer such questions? Let us see. — *I am planning a motor trip from New York to Buenos Aires; what is the best route west from the Canal Zone to Colombia?* No time at all; this is a frequent question. — From a state highway department: *Should we tie our surveys to the state coordinate system or to the polyconic projection?* Two hours. — From an Air Force official, who encloses five aerial photographs: *How accurately can you locate where these were taken, without using precision instruments?* Two months. But the Air Force thereby gained a new method of analysis in photogrammetry.

We could go on. Questions stream in, and it is important, indeed fundamental, to answer them if they are answerable, or to direct the inquirer to the proper source. For instance, the matter of the squirrel's teeth went to the electronic equipment of the Census Bureau and to M. I. T. The most innocuous question may prove to be the most baffling, a complex one to be absurdly simple. The exactness of the answer must be adjusted to the need of the inquirer.

The aptitude for reference is essential. One can, for example, arrive by calculation at the answer to the question, What is the boiling point of water at Colorado Springs? But that effort is spared, and the time conserved, if it occurs to the searcher that the key word is *hypsometry*, and he reaches for the appropriate tables. The advantages of organization are obvious. No one person could adequately service such a variety of inquiry as comes to us.

Consultation—the name by which we dignify this service to our scientific confreres and to the public at large—dips into the time of every person on the staff and threatens on occasion to become the tail that wags the dog. To forestall wherever possible needless interruptions of the work of our scientists, we are presently considering an administrative revision by which inquiries will be handled to a large extent by a consulting receptionist or be channeled by her to the proper experts. The matter is one of management, not of avoidance. The combination of resource materials represented by our collections and by the staff that handles them is not duplicated elsewhere. Moreover, the staff itself profits and grows stronger as a result of its responsibility in this field, and it is not unknown for a well-conceived inquiry to be the germ of an investigation of major importance.

At its highest level consultation holds the greatest importance, and within the service of information there exists none worthier than that rendered to a sister science. To our colleagues in learning we give freely, and in return we ask as much. For it is impressively clear that the orchestra of knowledge plays at its harmonious best when the players, one and all, listen with the willing ear.

RICHARD U. LIGHT

A Sense of Time and Place

When the Japanese seized Ocean (Banaba) Island, they deported or massacred the natives. When the British returned, they found the island in so ruinous a condition that the reassembled survivors were taken to Rambi in the Fijis, beautiful, well watered, fertile. Were the Banabans pleased at this turn in their fortunes? They were not. Accustomed only to their barren rock, they refused to plant crops "until starvation stared them in the face." Ocean Island is a speck in the vast Pacific, the Banabans a mere handful of people; but the story is a familiar one and susceptible of application to the most ambitious of welfare schemes on national or continental scale. For it is the "mystery of the contingent human event" that upsets the best-laid plan.

Time and Change

How can geography meet the challenges of planning? The theme is peculiarly appropriate to the inauguration of a new department of geography, as Dr. Isaiah Bowman recently used it at Rutgers University. In one way or another the articles in this issue of the *Geographical Review* illustrate the theme. To the layman they reveal some of the richness of geography; to the geographer they bring a reminder that in a rapidly changing world he must cultivate a sense of time as well as of place.

"Mbote!" "All quiet ahead!" is today's customary greeting in the Belgian Congo, where not so long ago tribal warfare, slavery, and cannibalism were rife. Robert L. Pendleton, soil scientist and student of tropical agriculture, returns from a visit to that great colony with enthusiasm for many of the developments which are rapidly changing the country. Especially does he have praise for the work of the agricultural experiment stations; the resettlement project in Buta territory, for instance, he describes as "one of the finest pieces of rural reconstruction I have ever seen." But neither Dr. Pendleton nor the colonial authorities are unaware of the dangers inherent in such swift transformations. Robert Godding, former Belgian Minister for the Colonies, speaking of the accomplishments of a quarter of a century, advises against undue haste and adds: "Let us never forget the wise French saying: 'Le temps se venge de ce qui a été fait sans lui.' "

Time has had its sure revenge in an earlier colonial development. The Maori revered and protected the forest; the European settler promptly set about its destruction, with the result that soil erosion is a notorious problem in present-day New Zealand. The circumstances are generally known; Kenneth Cumberland documents them in his reconstruction of the islands as they were in the generation after Cook's voyages. The

In the Pacific

Maori, who had reached New Zealand 400 years earlier, was intelligent and adaptable; it is instructive to see the changes he effected in his new home.

From this study of time past we turn to a changing scene in time present —the United States Trust Territory of the Pacific Islands. What changes shall we introduce in our efforts to promote the welfare of the islanders? Will the results match the intentions? There is a favorable augury in the expert knowledge that has already been assembled. Raymond Murphy, who contrasts two types of islands in the eastern Carolines, carried out research for CIMA (Coordinated Investigation of Micronesian Anthropology).

And we may add here that the story of the Banabans has a happy ending after all. Now that the initial shock of change is over, they have settled down to a prosperous existence. In 1948 they contributed £350 to the United Nations Appeal for Children (*Crown Colonist,* April, 1949)!

From Africa to Alaska

The seeds of the recent trouble in Durban were sown 90 years ago when provision was made for introducing Indian labor into the cane fields of Natal. Time has intensified the disharmony as this alien element has grown and flourished, competing with whites and blacks alike. To understand fully the complex and interacting elements of the situation, it would be necessary to trace all the environmental circumstances involved. For instance, the commission of inquiry sitting in Cape Town enumerates (dispatch of April 17) among the contributory causes of the race riots the "too rapid change from tribal to urban conditions" on the part of the Zulus. However, in any study of South Africa's Asiatic community, a first necessity is precise statistical data, such as are provided by Keith Buchanan and N. Hurwitz. Our readers will be interested to learn that the senior author is now having an opportunity to study dynamic change in another part of Africa. He has been appointed head of the geography department in the newly established University College of Ibadan, Nigeria, affiliated with the University of London. "We have an immense untouched field before us," he writes. "We are hoping to initiate in the immediate future a program of regional survey work centering on Ibadan city and extending later to the whole of southwest Nigeria. This is in addition to research topics in which the teaching staff has specialised. . . . The major limiting factor at present is shortage of literature. We look forward to getting the *Geographical Review;* our students have been immensely impressed by the back numbers which I have loaned them. . . . One final plea: cannot we have a little more space devoted to Africa?"

And another plea from Africa—from Makerere College, Kampala, Uganda, where also a department of geography has been newly created.

Victor C. R. Ford writes: "Here in East Africa we have a magnificent field for geographical research, and geography is clearly destined to be a subject of major importance in this College under the direction of Professor S. J. K. Baker . . . We have reached the stage where we are seriously handicapped by the lack of standard works of reference."

The Foreign Assistance Act applies a high purpose to a sizable part of the earth; but what about our own "dependent territory" of Alaska? The so-called "land of opportunity" has long remained at the frontier stage. Will statehood bring about the hoped-for development? Can we here "bridge logic and time"? In the matter of distance alone, the gap is immense. We shall have a better basis for answer when we have a greater knowledge of the physical conditions of the Territory. To take one small example: unexpectedly favorable climatic conditions met during a reconnaissance southwest of Cook Inlet suggest the possibility for a desirable air field.

Geographical Interpretation

We begin this July issue with an illustration of the capabilities of geographical interpretation drawn from Britain—the work of the geographers attached to the Ministry of Town and Country Planning. We conclude with an illustration drawn from Spain—geographical research on Aragon, a part of a government-sponsored program of integrated studies. A commentary on the widespread interest it has aroused is the fact that the two contributions making up the report arrived independently, one from Chicago, the other from southern England.

And finally, a word on the Sixteenth International Geographical Congress, held at Lisbon in April last. The wide range of the program, the variety of interests of the participants, surely is a key to appreciation of the service that geography can render "in deepening historical and economic interpretations, in enlarging our knowledge of the diversities of environments and cultures and the uneven timing of development that lies at the root of so many of our international difficulties."

While this editorial was in proof, the Society received the number of the *Geographical Journal* (published April, 1949) containing "The Geographical Situation of the United States in Relation to World Policies" by Isaiah Bowman, an address delivered in June, 1948, on the occasion of the presentation to him of the Patron's Medal for 1941. In it Dr. Bowman affirms the need of a sense of time and place. "In truth geography changes as rapidly as ideas and technologies change . . . Every major technical and power development must be followed by a resurvey of world geography, region by region and indeed point by point." G. M. W.

GEOGRAPHICAL INTERPRETATION*

ISAIAH BOWMAN

AT London, in June, 1948, I had the opportunity of talking with officers of the Ministry of Town and Country Planning about the work of the geographers who are employed to the number of forty or fifty as part of the staff of the Ministry. I heard only enthusiastic praise of this interesting new breed of scholars who had been trained in English universities. There are three kinds of things the geographers can do that have made them conspicuously useful. First, they can apply the wide-ranging data of geography expertly. This is especially true of cartographical material, a significant part of the work of the Ministry consisting of map synthesis and interpretation in the field and laboratory. Second, they have a singular capacity to put things together in regional frameworks appropriate to the decentralization of authority within the Ministry. Land use cannot be wisely determined if its consideration is limited to a desk in London. County councils make the primary decisions that affect the land, neighbor thus dealing with neighbor, as it were; and the first requirement in making a decision is an intimate knowledge of the local terrain and its possibilities. A geographer's advice to the local or regional authority broadens decisions; for the geographer is trained to look at the general principle as well as at the particular instance, to see the far as well as the near. Third, at least a few of the geographers have the capacity to go beyond the limits of their formal training and think creatively on the higher levels of land-use policy.

The good name that the geographers have acquired is the result of a long period of thinking and experimentation within the older universities about the points of view, the philosophy, and the validity of the specialized techniques of geography. For fifty years geography has been maturing and winning a place in higher education, until today schools and departments of geography are an established feature, whether one thinks of Oxford and Cambridge with their long traditions and prestige or of the newer universities that have been created or rapidly developed in the past 25 years in almost all the metropolitan centers of Great Britain.

The Limitations of Planning

Since I have chosen to identify one group of British geographers with local and national planning in the use of resources, a word of caution about

*From an address given at the inauguration of a Department of Geography at Rutgers University, April 6, 1949.

planning in general should preface my further remarks on its inexorability in Britain under the conditions of today.

In planning public policy "it is easier to cry 'Onward!' than to say whither." Or if the goal of action seems clear, the aim exceeds the grasp, and we are not sure of the means that always and everywhere tend to redefine or becloud the goal. To build a bridge between logic and time, that is, between a rational idea and its application here and now, calls for more than a neat social philosophy devised in a tower. Every proposal to improve the lot of man by taking heed of rationality or science has in it an element of mystery that science cannot eradicate—the mystery of the contingent human event. By this I mean the event that is also reshaped by unforeseen or accidental causes or that reflects human stupidity or caprice or honest differences of judgment among capable men as to the probable outcome of a proposed line of action. Every policy proposal must therefore begin with an *assumption* and end with an *if*. On the loom of life the emerging pattern is never regular.

Recently, in a company of men who had just heard an eminent sanitary engineer review the conditions of a sound public-health policy, one listener asked what would happen if all the public-health measures now in force should be suddenly discontinued. The answer was: "Half the men in this room would probably be dead in one year." Hearing this answer, one became less skeptical about *some* scientific planning, at least in the field of public health. Like much other social planning, sanitary planning is made more and more exigent by urban growth. Cities are in conflict on remote watersheds for water sources now become a bottleneck in industrial and population growth almost everywhere. Recreation, timber production, broader highways, slum clearance, river pollution, are a few among many additional sources of unending conflict in land and water use that require choices to be made and priorities to be established, and this in turn calls for a high degree of conscious planning and compromise among both plans and interests. The conflict between the ship and the mill on English rivers is one of the oldest that have called for continuing compromise on grounds of public welfare.

Great Britain was in a dangerous state at the close of World War II. In at least one vital respect she was still normal: character and staying power remained unweakened. She had to plan promptly in the way that a family must plan when the neighbor's children have whooping cough. Ninety-eight per cent of her merchantable timber had been cut, her land had been over-cropped in an effort to avert starvation—the goal of the Nazi submarine

campaign—and recovery would have become chaos if access to the materials of industry that were in short supply had been left to a mad scramble. The Board of Trade faced an almost impossible task, and no miracles could be expected from overseas colonial exertions. At home there were some things that could be done at once about forests, land use, fisheries, luxury consumption, and the rationing of food and clothing. Among these, land use stood high, and thoroughgoing geographical interpretation was required before a choice of uses could be made in the public interest.

By "geographical interpretation" I mean the interpretation of the elements of the environment by scientists who understand the origin and variability of those elements, the identification of crop and land-use achievements and possibilities which laboratory and field experimentation makes possible, and the play of related social processes which is involved in production and use by a rational society. Only in such an assemblage of interpreted facts, applied under agreed conditions by a dynamic society, can national policies avoid the hit-and-miss use that brings waste and destruction. Such an interpretation is old in concept but new in method. Thus the Inca rulers and their counselors were among the best empirical geographers the world has ever known. They recognized the broad regional differences of their severe environment, adapted crop levies to climatic possibilities, and even managed their forced migrations of settlers on the principle of acclimatization. They did not require the low-altitude man and the high-altitude man to change places. They learned the value of fallowing and of guano as a fertilizer. They experimented with new crops in likely situations. Their cosmography was feeble: they used the land and the sea without a systematic knowledge of the larger world outside. Their knowledge of landforms, hydraulics, and soil chemistry was empirical, whereas many of their social processes were experimental and rational. For us today the possibilities are greater than ever before, because of a diversified and powerful equipment of scientific principles, materials, and tools, and a scientific understanding of cause and effect in the play of forces only recently discovered.

The general need for a rational domestic land-use policy had become apparent to all classes of society in Britain after the First World War, and all political parties sought a long-range solution. By the close of the Second World War the situation had reached the point of crisis. A growing population, underfed by 20 per cent, raising but 40 per cent of its food, its land used for military purposes to the extent of 5 per cent in peacetime and 20 per cent in the late war, living in a time of uneasy peace, mining waste in some districts adding a local problem to the general one, a pervasive anxiety

about the preservation of restricted amenities—such large and varied perplexities required painstaking attention to every growing tree, every brook, and every productive acre. A Conservative government had initiated the study of such a policy, a National government had advanced it, and under a Labor government the final plan became fully operative (Act of 1947).[1] The authorizations given to the Ministry of Town and Country Planning represent the desire of the whole British public to strengthen the life of Britain by fitting the parts together so as to avoid waste of vital resources while increasing land production and public security by putting each plot and pightle to the highest use. Conscious of acute public danger, all parties supported the experiment of thoroughgoing control after intensive study of the local and national environment. The public knew that it could no longer "wait and see" but must try to foresee and forfend.

Land-use officials frankly recognize "the danger of crystallization of immature dogma" in carrying out the provisions of the Act. I had from one of them an astute observation upon professional institutes of planning: he felt that the most useful staff men are those without preclusive indoctrination regarding social program. Sound training in a group of related disciplines, with specialization in one, provides more depth and flexibility of thought than aggressive emphasis on social theory. When the state, being keeper at every field gate and wood lot as well as at every port entrance and exit, may change its mind frequently and even suddenly, Parliament, representing the people, must also protect its citizens from the consequences of its own acts when, as often happens, plan and plan conflict. Or should one say when dogma fights dogma? Organizational complexity in Britain seems to have reached the limit of human capacity to operate rationally, yet no one seems able to simplify what danger and crowding have made disturbingly complex. The inner contradictions of planning represent its chief limitation, the complexity its chief danger. The more complex a plan, the further it goes beyond the interest and competence of the everyday citizen. This is a weakness that a Communist government has fully exploited in the Soviet Union. We are fortunate to have been able to keep in our younger and more spacious land more room for individual choice and enterprise, a condition that irks only the amateur planner, who, wishing to hustle social evolution, is likely to think in the barren terms of mere logic and control. Therefore too large a conclusion for our present economy and social structure should not be drawn from current British experience.

[1] See "Post-war Britain, 1948–49," Central Office of Information, London, pp. 33–34. (Distributed by British Information Services, New York City.)

Geographical Science and Social Value

In the United States, in the past 50 years, geography has had a development similar to that in Great Britain, until hardly a major university is without a separate department of geography, so insistent is the demand for it on the part of policy makers, educational experts, scholars in other fields of learning that make use of geographical principles and data, and students themselves who seek careers in geography, some of them in academic work and perhaps a larger number (now several hundred) in public service. To an increasing degree it is recognized that training in geography has a scientific disciplinary value as definite and substantial, if not as austere, as training in physics, chemistry, or biology. What the laboratory is to the physicist, the *field* is to the geographer. Men who live on the land have made a wide variety of experiments at all stages of cultural advancement and in a wide range of environments. Their results are open to observation and critical analysis and comparison. In addition, planned experiments in resource development have required the use of scientific controls and thus have quickened the pace of sound experimentation. To a corresponding degree the field of geographical interpretation has widened and deepened. A regional synthesis of social life requires an investigator to think all around his subject.

I need not review the place of geography elsewhere, further to illustrate my point that in the highest centers of culture, and in the most advanced countries of the world, geographical science is now regarded as an essential element of a well-rounded education. What is not so clearly perceived is the nature of geography and the points of view of geography—only a few of which are indicated here—that make its study indispensable if we seek the depth of understanding required in thinking, planning, and executing policies that affect our national welfare and, to a high degree, the peace and security of the world.

The last point is a crucial one. For while we go about our daily business as if the world were inevitably to continue in one way or another with its highly organized and precariously balanced social and industrial life, we must realize that unless we have peace and security under conditions of liberty, with room for personal dignity, initiative, and enterprise, our standard of living will fall and our whole social structure may be fatally weakened. The cost of our recent wars must be paid, and a better use of resources and higher productivity will help to prevent its payment under conditions of misery and disorder. This is another way of saying that we cannot afford to neglect any subject of study or any point of view that gives

us a better understanding of the world, its resources, diversities, and potentialities. All the fundamental things that affect our capacity to produce and to work together for mutual benefit in a peaceful world must be brought to bear upon the problem of sustaining the structure of our diverse and flexible Western civilization.

Measurement and Policy

What is the nature of geographical thinking? In part it is like all thinking; for although it may begin with accidental or systematic elements, or even the notional elements of reverie, it becomes *critical* in the end. This means that it sorts out importances and apparent relationships, answers the skepticisms that should arise in every trained mind, and searches relentlessly for cause-and-effect relations. Once we know what causes a thing, we can more rationally and quickly plan its control. Speed and sureness of control of agreed critical elements, such as public health, are more and more urgent as population density and complexity increase. Geographical thinking starts with an observation or an idea. All geographers recognize the indispensability of field observation. With his own specific training and a body of individual ideas every geographer is surprised on reaching what is to him new territory to find how much has gone unobserved and unrecorded. It may be a bit of local climatology that blazes with meaning, or a food source, or a social idea confirmed by centuries of experience in a specific environment. Questions begin. How much and where and why and what else *could be* are the whirling electrons of the curiosity atom in man? We single out *how much* for further comment.

Measurement, and if possible exact measurement, is one of the basic elements of most scientific research. In geography, maps are the commonest records of field measurements, reduced to conventional symbolism as a condition of comparative use. To the layman all maps look pretty much alike except as to color, but to the geographer original surveys, projection, scale, technique of construction, symbolism, and relative reliability are the first objects of study if the map is to be used as an instrument of interpretation. One of the conditions of Napoleon's military genius was its support by extraordinarily good maps. From a limited topographic point of view one would find the maps of his time still useful. He was a quick and skillful student of maps, and his geographical epigrams still have wide currency. He had what some would call today a "geopolitical" sense, but I dislike that pretentious word extremely and prefer the simple and customary phrase "geographical sense."

At one point Napoleon made a serious mistake in exercising his geographical sense. He had persuaded himself, perhaps by the brilliance of his victories and his almost uniform success whatever the terrain, that he could invade and conquer England. Like Hitler, he had to give up the scheme. He learned, as Hitler did, that even a narrow belt of water (it is little more than 20 miles wide at its narrowest) has a high strategic value. A narrow belt of salt water is a terrific obstacle, because one can neither wade through it nor improvise a bridge over it. One must counter its tidal vagaries and the caprice of wind and wave and cross it in full military panoply against resistance that has room for naval maneuver and fleets within call, as the captains of the Spanish Armada discovered. Hitler thought that his airplanes in our Air Age had overturned that centuries-old doctrine and diminished the value of the Channel so greatly that he could venture to ferry troops across it under an air umbrella. He thought that he could gain maneuverability in the air, knowing that he could not win it on the sea. Other factors also played upon the scene, such as the will of the British, the gallantry and self-sacrifice of the Royal Air Force, the overwhelming power of the British Navy to destroy the surface craft of an invading force, and the limited range of the mass of aircraft available at the time, which worked in favor of the island defenders. Skill and an inspiring tradition also had their place: "Whatever our shortcomings, we understood the sea affair very thoroughly."[2] Yet the basic factor in the whole invasion strategy was that narrow strip of water, the salt-water girdle of Britain. Once armed on the one side with modern industry and on the other side with a fleet commanded by superior sea-fighters, Britain was advantaged by its geography to a degree that has enabled it to remain if not inviolate at least independent.

Geographical elements of strategy about which a Napoleon may be mistaken are obviously not measurable by a laboratory balance or disposed of by a mathematical formula. Behind their employment must be human judgments about humans. No one can measure a geographical fact, however physical and concrete, and say: "There you are. Feed this precise fact into a calculating machine or a general-staff evaluation, and it will tell you what to do with a given military component or instrument at a designated moment of time." Always there must be something more than an array of facts and figures; there must be a judgment upon and about the humans who are involved, as to what they can do, or may do, or may be persuaded to do. And judgment lies in the realm of the imponderable. No man can claim to be infallible or purely "scientific" as he navigates around the misty headlands of

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[2] Winston Churchill: Their Finest Hour, Houghton Mifflin Company, Boston, 1949, p. 314.

human behavior. "In the greater matters of life the mind must fling itself forward beyond its data."[3]

Yet measurement is an essential precursor of most human judgments affecting either broad or parochial questions of policy, military or civilian. Many of the problems of land use, water use, forest use, resource use in general, can be solved only if we have fairly reliable measurements of their elements. Before we can determine the rate of forest cutting on a given tract of land, we must know the growth rate of trees throughout their life cycle. What to cut and when to cut it are questions that can be answered only after careful measurement and scientific understanding of the biology of the tree in relation to its geographical environment. Measurement offers a further advantage. If the imponderables of both good and bad human behavior limit the application of science in human society, it is also true that the area of the imponderables is narrowed by science. Scientific measurement reduces the scope of guesswork and sets narrower bounds to uncertainty. We all have to be reminded how wide is the sea where submarines may hide in wartime, while each new discovery in the field of matter and power and speed requires oceanographic remeasurement for the opposite reason. Ruler and protractor have now to be flexible, not rigid, and an index of flexibility is as important in geographical interpretation as a scale of miles.

Geography a Changing Subject

From the standpoint of social application and use the world of intellect and materials is a vast interpenetrating complex of forces. We cannot carry all of it in our heads all the time or at any time. For some kinds of scientific discovery we must narrow the view in order to deepen the understanding through intensive concentration upon a given line of thought. Seen in this light, specialization is indispensable. The world has never known a thinker who was not exceptionally expert in some field. His expertness is his ticket of admission to the main tent. Once a discovery is made, one must then look at the framework or mosaic within which the newly acquired knowledge has its place, whether in science or life. Thus every scientist becomes in time a social instrument, in thought or at all events in effect. Through him forces are generated that impinge on life and may change life, here to its improvement, there to its loss.

Geography happens to be a science that is more largely and directly social than almost any other. That is why it has proved so useful to depart-

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[3] John Buchan (Lord Tweedsmuir): The Pilgrim's Way, Houghton Mifflin Company, Boston, 1940, p. 209 (in commenting upon F. S. Oliver, M. P.).

ments of history, international affairs, biology, government, and social structures and process. That is also why geography is a changing subject. How often we have heard otherwise intelligent men say, "The geography of the earth is *fixed*, but the history of the earth *changes*." The contrast is invalid. The geography of the earth changes, and at times and places it changes profoundly. One could illustrate the fact from the climatic changes that have taken place since the time of the cave man, or the change that has come over man's earth through soil erosion and deforestation, some of it by natural processes, other parts by the influence of man.

But it is not on the physical side that geography changes most. The geographer is concerned with relationships as well as with the things related. The social evolution of human societies has been speeded by modern science and engineering and by the spread of technically equipped migrants over most of the habitable lands. A changing society has thus encountered in its pioneering advance a series of diversified environments, where the climate is too hot or too cold, or the land too wet or too dry. The pioneer fringe has been a laboratory, priceless to historian and geographer alike, in which young and experimental societies adapt themselves to new conditions and new cultural practices and techniques, with a minimum of city influence. However, in this century, to a higher degree than ever before, the pioneer depends upon crop experimentation to tell him how to counter the physical conditions of his marginal environment, and upon government to give him schools, community houses, telephones, library facilities, medical service, and highway or railway right from the start. He is aware of his marginal position as to crops and climate but equally aware of the power of his government to make up the chief environmental and social deficiencies. The modern pioneer asks government to assume many of the risks of his venture.

In those parts of Africa where white settlement is possible and where there is a substantial native population to be considered, all sorts of collateral questions confront the pioneer. Shall the device of native reserves be extended? What wages are fair and right? Even the diet of the native worker is supervised to see that calories and work are in balance. This is pioneer settlement by contract, the white man setting the standards of his own behavior. The geographer is no less in evidence as the bounds of native reserves are established in relation to native culture and subsistence requirements, and as the productive white man's acres are related to mine, forest, transport, and labor supply. The African sector of British imperial defense is based largely upon a new interpretation of the map of Africa with machine and mileage linked to each other and to the terrain and climate. The remote

pioneer of today may be at the center of howling activity tomorrow, wide-winged technology descending upon him from the sky. To a larger degree than ever, the economic life of the pioneer land settler in Africa and elsewhere is a thread in a web, not a completed garment. He does not keep the account books of the world. He must buy and sell on terms that others set for him. The arithmetic of pioneering is growing more complex everywhere.

Underdeveloped countries depend as a rule upon outside sources of capital, which comes in under its own conditions and rules. Suddenly, in Arabia, capital is no longer a product of long and slow accumulation but springs from the ground overnight, and a royalty share of it, gained without effort, is applied to engineering works that conserve water and permit control of its use and the growth of population and production in a land of niggardly endowment. Scientific oil exploration, unlocking one resource, had the indirect effect of unlocking another. An uninhabited earth has a physical geography that changes constantly but slowly. To a revolutionary degree man changes his geography as he goes along. When mind is introduced, the earth's meaning changes rapidly and constantly. A "calculus of variations" is one of the essential tools of pioneer-settlement research today.

Modern biochemistry has introduced a new dynamic in geographical interpretation. Every productive region, old as well as new, must be reappraised in terms of what science can do to change either soils or plants, sometimes to fit the thing produced and sometimes to change the environment to suit the demands of production. When the first black soils of the swampy Everglades were cleared in the expectation of bountiful harvests of garden truck, it was found that the first mature celery to be grown was green, soft, and watery. Lacking firmness and taste, it was unsaleable. It was found by experiment that the addition of almost infinitesimal amounts of copper supplied the missing qualities. It was also found, on soils elsewhere—some new, some partly exhausted by 100 to 200 years of cultivation—that one or more of a number of elements, among them boron, cobalt, manganese, molybdenum, and zinc, might be required for healthy crops and were absent or deficient in many cases. The study of these so-called "trace elements" or "micronutrients" has disclosed that they play a critical role in the physiology of plants, animals, and men. Today, in a score of places in England, Australia, New Zealand, Africa, Canada, and the United States, the study of trace elements has been intensified in the attempt to learn their role in plant biology and economy. Here is a definite area in which *man can change his environment*. The evidence is clear and convincing. What is not so clear is how the effects of trace elements are achieved and what

balance there is between them and the other biochemical processes that affect the welfare and growth of plants, animals, and men.

In Delamere's grant in Kenya the effects of trace-element deficiencies made their appearance 40 years ago on comparatively new soil. The disease known as "Nakuruitis" swept away cattle and sheep wholesale. Today the land carries livestock that is in excellent condition owing to a weekly ration of cobalt. A chemist from New Zealand, where similar difficulties had arisen, had found the cure and brought into production again a soil so light and thin and poorly endowed as to be worn out otherwise in a few years.[4] The story is the same in Australia, where a revolution in the livestock industry of the Ninety Mile Desert of South Australia is under way, with two million acres of "waste land" reclaimed by the application of extremely small amounts of copper sulphate and zinc sulphate used in conjunction with superphosphate. In many parts of the United States and Canada "deficiency diseases" in cattle have been cured by the same means, principally in areas where long cropping has used up the small original amounts of micronutrients whose existence and role went unnoticed until recent years.

Dependent Territories

When the Foreign Assistance Act of 1948 came into effect, it opened up a vista of public benefits not confined to the United States or Western Europe; for "dependent territories" then became a part of the general problem of world recovery. Production is everywhere the great need of the hour.[5] Unless we increase production, we can neither pay our war debts nor maintain the standard of living, much less raise it. A higher standard of living for the depressed areas must be one goal of united endeavor if we are to counter the menace of Communism. Long before World War II it was clear that the Soviet leaders had their eyes fixed upon dependent territories as a rich field of doctrinal exploitation. Outspokenly determined to destroy the non-Communist world, they found in colonies and other dependent territories the means to cultivate that disorder, division, and confusion of thought in which Communist doctrine flourishes and to reduce, if not entirely cut off,

[4] Elspeth Huxley: The Sorcerer's Apprentice: A Journey through East Africa, London, 1948, pp. 326–329.

[5] However, when production is forced, problems of overproduction and price control inevitably appear. Already following the period of high production to meet the world's need during and since the war a world wheat conference has convened (1949) to deal with the basic issues of price, duration of agreement, and quantities exported and imported. We are at the stage where international agreement on production must be followed by agreement to control, and price and quantities are the two chief variables for negotiation.

the sources of certain raw materials essential to industry in Western Europe and the United States. Communism fed discontent among the dependent peoples of the world by asserting "capitalistic exploitation" as the beginning and end of the story of trade and of primary and industrial production.

It would be easy to document the shortcomings of the colonial powers. It is equally easy to slight their record of beneficent achievements. We no longer think of the abolition of slavery in the world—or most of the world. That is an old story, but it was precisely the "capitalist" powers that brought human purchase and sale to an end. It is seldom realized to what an extent slavery was prevalent in territories outside the reach of the colonial powers. It is said that colonials should have more benefit than they now receive from their production. This is undeniably true in some cases where a runaway population increase (because of better production and health measures) keeps the standard of living at subsistence level while development possibilities are neglected. Yet in most colonies there would be no production for export if it were not for the industrial demands, the ships, the aggregates of investment capital, the commercial organization and experience, the creative and practical business minds, the identification of sources of coal and electric and water power that depend upon the scientific discoveries, technical skills, and commercial enterprise of the so-called "exploiters." As important as the question of the division of benefits between colony and metropole is the paradox of population increase that keeps the standard of living down while the white man's own standards of health and public order, exported to the colonies, aid that population increase. Plan meets plan head on, and logic and time remain unbridged. Policy is thus impaled on the horns of a dilemma.

Most criticisms of colonialism have been built around key words employed carelessly. "Nationalism" and "imperialism" have become dirty names. We have only to hurl them at any great power, and we think we have argued a point. Can the primitive mind resist the deceptive influence of the iteration of half-truths? The Kremlin leaders saw the value of this blunt instrument applied to simple minds. Even during the most critical days of the war, plans for postwar extension of Communism moved forward with little reduction in speed. This was the dark reality that lay behind so-called "Allied cooperation," the skeleton in the closet while the war was on. The toasts of the Allied leaders at their several conferences were in sharp contrast with the vast force of demoralization that the Politburo was already turning loose upon the world.

At the close of World War I the political force of international conscience entered the scene when it was recognized that the politically, socially, and

industrially immature peoples of the surrendered German colonies could not survive "under the strenuous conditions of the modern world" if turned loose to shift for themselves. The mandate system was set up, responsibility for fair dealing on the part of the colonial powers being lodged in the League of Nations. In 1945, with the creation of the United Nations, this responsibility was vested in one of its organs, the Trusteeship Council. Here the peoples of former German colonies have a forum, and so too have any other groups placed voluntarily under Trusteeship Council guidance by the colonial powers.

Yet the fatal ratio persists between production and native population, no matter what the forms of political amelioration. No doctrine is sweet to the man whose standard of living is at the lowest possible level, unless it yields bread today. The display of the white man's higher standards is a constant reminder to the native that someone is receiving, somehow, goods on a scale higher than his own. The creation of the means of production by outside capital brings men who enjoy the highest standards of material welfare into primitive societies where the contrast is most provocative. Production on a significant commercial scale is not possible without joining the interests of a colonial group to the larger aggregates and structures of industrial life in the countries where venture capital has accumulated. Behind that accumulation is a long history that cannot be revoked and a fact of life that no human device can suppress. To understand that history and that fact requires a brief digression respecting time and place.

A Sense of Time and Place

A man is not educated who lacks a sense of time and place. Where are we in time, where do we live? It was not given to thinking men to change the world overnight—it takes time to change even in small degree at one place. "Place" conditions and therefore limits endeavor whether the place is large or small. Emerson reminds us that we have not been invited to run the universe. Nor did we make the earth or the fullness and diversities thereof. All life on the earth has been unequal in its parts throughout time, from the beginning. Some streams of migration early and late moved into favorable sites, others into rigorous environments. Cultures arose as the mind of man conceived ideas, codes, language, tools, foods, adornments, and beliefs. Endless creative interplay between mind and matter ensued, between culture and environment, wherever men were free to choose, reject, or modify. When a new idea about the environment was adopted, it was as if the environment itself had been changed. What had been neglected

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was found to have use. Primitive man did not mine coal and start mills and factories. All this is a result of slow growth as progressive discovery and development changed both the meaning and use of the earth and changed them unevenly from place to place.

At no time in the world have things been equal, nor could anyone stop the processes of idea making, invention, and unequal distribution of benefits and make all societies alike in a world where men are still in general living close to their different environments. Some people have been advantaged by their environment, others have pursued the same low cultural pattern in the same forbidding sites over endless generations. The great force of literacy came upon the scene with revolutionary effects. Through it men learned about each other, so that all men are becoming more and more conscious of their condition. They are comparing themselves with others. This is as true of you and me as it is of native and plantation owner, the peasant grower of peanuts in the Gambia and the captain of the port through which the peanuts are transported on their way to the white man's market.

Nor may one consider turning back the clock and stopping the growth of literacy. If immature peoples are to become self-governing because of the pricks of conscience of their present rulers, they will fail in the end unless they are informed as to the possibilities and penalties of acts that history spreads before them. If we mean to improve colonial societies through a greater measure of freedom, we must first show them how to educate themselves in the better use of their resources.

In implementing the Foreign Assistance Act the endeavor is to raise production by a vigorous sustained attack upon possibilities, in both metropole and colony. The widely varied technical aspects we need not consider in this place. The lift thus afforded, timed to agree with practical measures of partnership between colony and metropole as already announced by most colonial powers, may reduce the contrasts in standards that now help bedevil world politics. The complex and delicate structures of the modern industrial world, if wrecked, would only bring all peoples down in ruin. Conscience, as expressed in signed trusteeship declarations, demands that we explore every avenue that promises to lead to a rise in the standard of living of those now lost in a maze of changes both in their own environments and cultures and in their relations to the outside world. Material and cultural improvements must come first, or self-government will be an empty shell.

No person and no government has been able to invoke any form of magic that would equalize things in this diverse world. Without a sense of time and place one can irresponsibly argue that things *should* be equal. Such

argument is sometimes called idealistic because it is cast in terms of equal good. I should call it foolishness because it disregards the necessities of *the next step.* It is easy to picture Utopia; it is difficult to point in its direction and to describe a path to it. World government is the latest of the utopias. Let every country subject itself to the overlordship of a central committee. Whose committee? What is to be the philosophy of the committee: Communism or democracy? When someone suggested to Gromyko a great series of classics to help unify the world, he said: "Three questions: whose classics, what language, who pays?" No one has yet been able to show how we can have world government without force, and force means war. What the advocates of world government are really saying is that they want war in order to get one government. They will not face this inescapable argument and conclusion. They will not tell us what the first, second, third, and fourth steps are, today and tomorrow.

In discussing the question of dependent territories in these terms, I have tried to lead you from mainly geographical considerations to the point where the complexity of events and the interpenetration of disciplines and the community of interests of scientists, social scientists, and statesmen are apparent. In the larger context of life one cannot provide a neat and narrow definition of geography. Each "subject" is an assembly of expert knowledge that fulfills its social purpose when it is merged with other pieces of knowledge, to arrive at broad understandings of practical value that bear on society and that can be built into public policy. Who cares to measure the quantity of each ingredient—economic, political, or scientific—that policy contains from moment to moment? New powers of analysis are not derived from pedantic definitions of subject matter. The essence of a thing is not in its definition. Obviously, to gain the advantages that specialization brings, we need to name our disciplines and define our departments and provide a structure within which investigation and training take place. But this is merely administrative order in school and university; it is not life.

Defense in Depth

What I have said about geography is no less true of subjects marginal to it. Those who have worked under the philosophy of mutuality of scholarly interest can appreciate the service that scientific geography renders in deepening historical and economic interpretations, in enlarging our knowledge of the diversities of environments and cultures and *uneven timing of development* that lie at the root of so many of our international difficulties. These diversities need not be an ineradicable curse. They can be an advantage, as

one of the greatest of the geographers, Alexander von Humboldt, pointed out 150 years ago when he asserted that if all the rich resources of the earth were available to all the people on the earth (we would now add: "who had the wit and enterprise to develop or secure them"), then would enjoyment of those resources be commensurate with the opportunities.

Geography as a discipline has its fascinating aspects. I like the life and landscapes of deserts, but I have never been able to say adequately why I like them. They make a powerful esthetic and emotional appeal to me. Other geographers find beauties and satisfactions in other societies and environments. Professor Fleure has a unique definition: "Geography is what I like." You see a large element of his philosophy in my wandering discourse tonight. There is a core of geographical knowledge, some of it scientific, some of it systematically ordered and arranged, and much of it capable of assisting the scholar, the statesman, the manager of industry, to understand the earth better, which can mean to use it in a better way for mutual benefit. Today this can also mean the achievement of a humane "defense in depth," to resist the forces of Communism that derive their strength from degradation of manliness and character, from an exclusive materialism, from confusion among nations and societies, our own no less than those of dependent peoples, and from forms of slavery of thought and person for which death is a welcome alternative to hundreds of millions of men and women who are still free to choose.

THE BELGIAN CONGO: IMPRESSIONS OF A CHANGING REGION*

ROBERT L. PENDLETON

NATURE and its unique history combine to make the Belgian Congo a region of particular interest to the geographer. I had spent many years in the Asiatic tropics and many months in the American tropics, so I welcomed the opportunity of visiting their African counterpart. These notes were written in the field, on the S.S. *Reine Astrid,* on the Congo itself. It is not possible to make a full documentation here, but the footnote references call attention to the large and growing body of scientific literature on the Belgian Congo.[1]

Congo Contrasts

In contrast with many other colonial territories, development in Central Africa has been by jumps rather than by slow stages. Even yet the Africans do not use the wheel in their native culture; nevertheless, almost unaided they operate modern railroads, maintain and navigate river steamers, and drive automobiles and trucks, and they operate relatively complicated factories with a minimum of foreign assistance and supervision. They had no draft animals, and therefore no plows for food or fiber production; yet they

* I am deeply indebted to M. Sladden, director of the Department of Agriculture, and M. Corin, director of the Geological Survey, of the Belgian Congo Government; M. Jurion, director of INÉAC, and Dr. Louis van den Berghe, director of IRSAC, and their staffs for thousands of kilometers of road transportation, for hospitality at many experiment stations, and for much other help without which this study could not have been made. My stay in the Belgian Congo was from September, 1948, to February, 1949.

[1] To view the Belgian Congo in its African setting, one cannot overlook Lord Hailey: An African Survey, London, New York, Toronto, 1938 (containing 171 pp. of index—most unusual for a British book!). A companion volume, resulting from the same survey, is E. B. Worthington: Science in Africa, London, New York, Toronto, 1938. (See reviews in the *Geogr. Rev.*, Vol. 29, 1939, pp. 653–656.) A second edition of Lord Hailey's book was published in 1945.

For the traveler a most useful publication is *Congo-Nil 1948*, published by Chemins de Fer Vicinaux du Congo. A new edition appears every year or so.

The best general description of the physical features and setting of the Belgian Congo is found in James P. Chapin's "The Birds of the Belgian Congo," Part I, *Bull. Amer. Museum of Nat. Hist.*, Vol. 65, 1932, Section A.

J.-P. Harroy: Afrique, terre qui meurt, Brussels, 1944, is an outstanding book, dealing with the social problems of the Blacks, the comparative colonial policy of the British, French, and Belgians, and other problems of the impact of the European on the natives as well as with problems in conservation (see the *Geogr. Rev.*, Vol. 39, 1949, p. 93).

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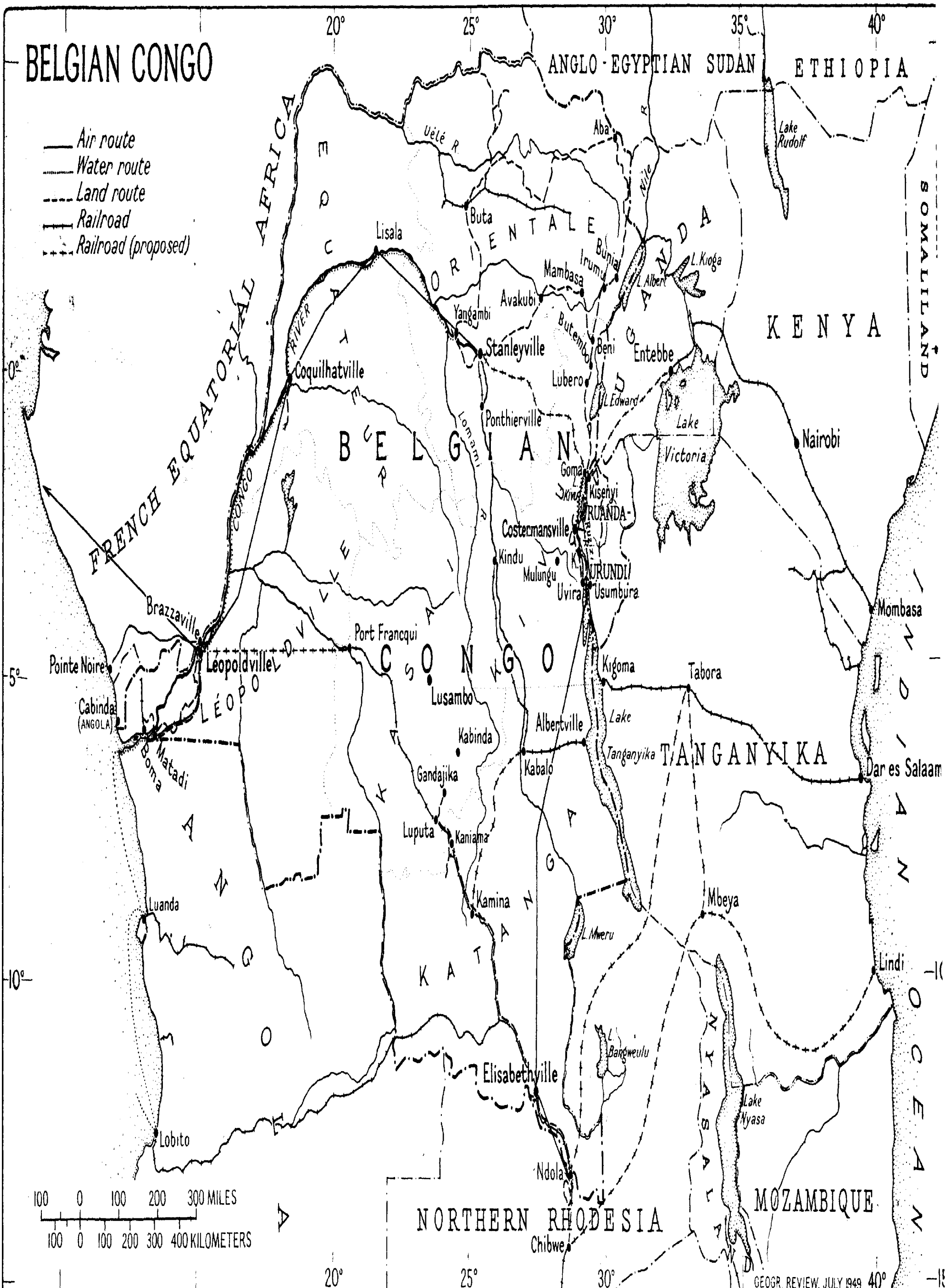

FIG. 1—Map of the Belgian Congo showing the author's routes and the railroad connections, existing and proposed, between the colony and bordering countries. The line between Pointe Noire and Brazzaville should carry the railroad symbol; it is the Congo-Océan line. Scale approximately 1 : 17,000,000.

run tractors. An experienced mechanic at an agricultural experiment station could earn a handsome salary, but since he has already bought two wives and has plenty to eat and wear, he considers he lives well enough by working only one-third of the time. The hoe and the machete remain the principal farming tools, but better-wearing kinds of steel have greatly improved their quality and effectiveness.

Modern towns and cities, with hospitals, schools, and churches, are the places of residence of nearly 4 per cent of the native population of the Congo, now estimated at 11 million. Most of these city dwellers live in relatively substantial houses, larger than those in the villages, and have medical, public-health, and sanitary facilities; they can usually buy food they like, and physically and financially they are much better off than the natives living in scattered villages in the forest. In the country a large proportion of the natives now live in more or less regular villages along the main and secondary highways through the forest or in orderly villages along the riverbanks; for the administrative officials have insisted on moving the village sites to locations that facilitate general supervision and control, especially of the "educative" agriculture in its various forms.

Stern-wheel steamers, burning cordwood and refueling while tied up for the night, enormously increased water transport over that possible with the dugout canoe; now Diesel-powered, propeller-driven boats are replacing the stern-wheelers, and lighted buoys and shore lights being installed in the Congo above Léopoldville will permit night navigation. Railroads and motor trucks have extended manyfold the radius of travel possible on foot or in a litter and have enormously increased the amount of freight, formerly limited to what men could carry on their heads.

Although the tom-toms of the central Congo can, under particularly favorable weather conditions, be heard for 50 miles and can transmit by code relatively complicated messages, obviously the radio, telegraph, and radio telephone are infinitely more effective, with a working radius often reaching throughout the Congo.

Another spectacular contrast is that between the huge ore flotation and reduction works at the mines in the Katanga and the primitive charcoal furnaces for the smelting of iron and copper, blown by means of skins tied over wooden funnels.

Vegetational Changes

Changes are not confined to mechanical introductions; equally striking and more serious changes are taking place in the vegetation of the Congo.

FIG. 2—Coquilhatville, almost under the equator, on the Congo River is the capital of Equateur Province. Steamer landing at the left; coconut palms line the bankside road.

FIG. 3—Looking downstream across islands in the Congo River below Lisala.

FIG. 4—Looking south across the Butembo Valley, west of Lake Edward. Village on hilltop; vegetation mostly tall wild grass with some relics of climax forest and planted eucalypts. Altitude over 5000 feet.

FIG. 5—A mission station on the higher ground north of the Congo River, just below Lisala.

Particularly to the south, west, and north of the central and densest equatorial forests, there are vast savannas which are burned every year, and under which the soil has deteriorated. The area of savanna is increasing at the expense of the forest. For example, the railroad between Matadi and Léopoldville passes through considerable expanses of man-made savanna (Fig. 6); the highly undesirable cogon grass (*Imperata cylindrica*) is an important component of the vegetation. In parts of formerly cattleless country, where not prohibited by the tsetse fly, some cattle are being raised on the scanty, poor pasture of the savannas. Production of certain food crops in the savanna country is difficult, and returns are small per unit area; fiber production (*Urena* or *Agave* spp.) is practically impossible. The loss in potential productivity is serious.

Deforestation has been hastened by the compulsory cultivation of foodstuffs, especially manioc (cassava), upland rice, maize, beans, and, in the mountains, wheat, for feeding the cities, the miners, and others who have left the rural villages. For export, as well as for manufacture in Léopoldville, cotton is grown in the Uélé (north) and the Lomami (south). Especially during the war, when *Urena lobata* was produced in quantity for cordage, forest destruction for this crop was particularly serious.

Europeans have been slow to admit that North Temperate Zone methods of soil management and crop production can rarely be applied to annual field crops under heavy rainfall at low latitudes. Under such conditions the more extreme forms of lixivium soils are developed—soils with the lowest quantities of available plant nutrients. But in this matter, too, a change has come about, and the agricultural scientists of the Institut National pour l'Étude Agronomique du Congo Belge (INÉAC) are foremost in appreciating the rapid degradation of fertility that follows the growth of clean cultivated crops, such as cotton and the grains, in the clearings in the equatorial forest.[2]

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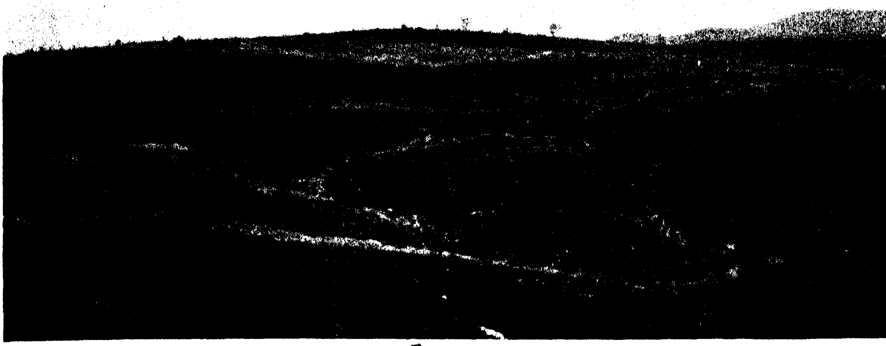
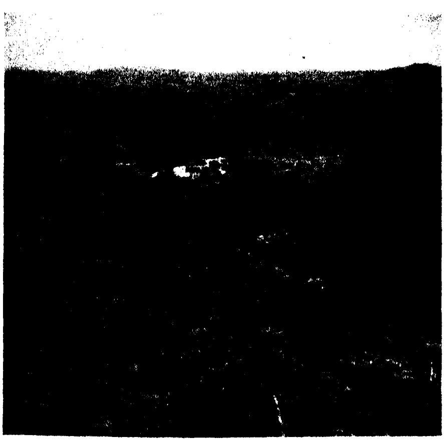
[2] Growing concern is reflected in, for instance, "Les terrains superficiels, les sols et leur mise en valeur," pp. 1–45 in a supplement (Liége, 1948) to the third edition of Maurice Robert's "Le Congo physique" (Liége, 1946). See also René Thomas: Soil Deterioration in the Belgian Congo: The Necessity of Soil Conservation and the Possibility of Soil Reclamation Work, *Internatl. Rev. of Agric.*, Vol. 33, 1942, pp. 133T–165T; G. Tondeur: La conservation du sol au Congo belge, *Bull. Agric. du Congo Belge*, Vol. 38, 1947, pp. 211–314.

However, by all odds the best and most recent publication, containing papers by recognized scientists, both in the Belgian Congo and in the neighboring equatorial colonies of France, Great Britain, and Portugal, is "Comptes rendus de la Semaine Agricole de Yangambi (du 26 février au 5 mars 1947)," 2 vols., *Publs. Inst. Natl. pour l'Étude Agronomique du Congo Belge (INÉAC)*, Brussels, 1947 (28 papers on cultural methods and protection of the soil, 9 on native agriculture and food crops, 14 on plantation and industrial crops, 8 on fiber crops, 12 on pedology and climate, 6 on agricultural pests and diseases, 13 on economic and social questions, 8 on forestry).

In November, 1948, there was held at Goma, on Lake Kivu, Belgian Congo, the first African Conference on Soils, in which several of these same subjects were further considered by specialists from many parts of Africa south of the Sahara. See Robert L. Pendleton: "The African Conference on Soils at Goma, Belgian Congo," *Soil Science*, June, 1949.





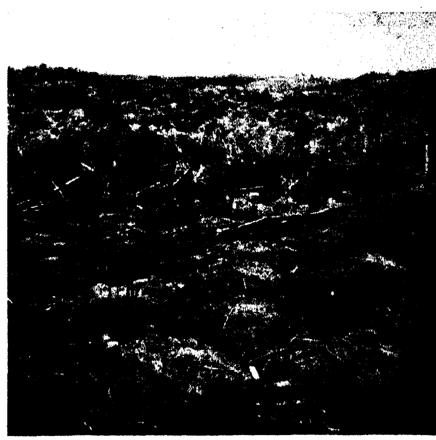


FIG. 6—Fire-climax savanna on a poor, stony soil is all that remains of the vegetation in much of the Lower Congo, between Matadi and Léopoldville.

FIG. 7—Burning in fire-savanna country preparatory to planting another crop of cassava. Lower Congo.

FIG. 8 (left)—Village on a ridge southwest of Léopoldville. Repeated kaingining and annual fires keep the vegetation suppressed on the poor sandy soil. Altitude 1300 feet.

FIG. 9 (right)—Small kaingin in the sandy hills about 60 miles southwest of Léopoldville. Cassava cuttings planted in soil mounds. Altitude 1300 feet.

If the value of the crops justified it, commercial fertilizers or composts could be used to maintain fertility, but the low value of the crops and the cost of the fertilizer preclude any extensive use. Great strides have been made in working out rotations and interplanting, in the discovery of unusual and much more effective cover crops, and in other "natural" methods of managing the poor soils so that they will continue to produce moderate crops.

Introduction of supposedly beneficial plants may have serious results. *Mimosa invisa,* a thorny leguminous vine, used in Java as a cover crop, has most unfortunately been introduced into the Congo. It was noted in a few localities. On the other hand, *Leucaena glauca,* a rapidly growing leguminous shrub from Middle America, introduced as partial shade for coffee, is distinctly useful; in places it is used as a hedge for terrace edges, and it may in time become a browse plant.

Agricultural research for the entire colony and for the Trust Territory of Ruanda Urundi is carried on by the privately operated but government-supported INÉAC. The scientific staff of about 75 Belgians is located at 24 widely scattered agricultural experiment stations. In 1947 an "agronomic week" was held at Yangambi, the headquarters of INÉAC.

Important advances are being made in meteorological study, especially in its ecological applications;[3] the air lines also need better meteorological data. Research in the pure and other applied sciences, including the social sciences, is to be fostered by the Institut pour la Recherche Scientifique en Afrique Centrale (IRSAC),[4] also entirely government-supported.

The Native Peoples

The most significant and not altogether happy changes are taking place in the native peoples. The Blacks, as they are usually called, belong to many different tribes. As a result of the extreme isolation that prevailed among them until recently, there are a large number of mutually unintelligible dialects. The smelting of iron and copper ore for spears and other tools seems to have been their highest art, and hunting their principal craft. Usually the

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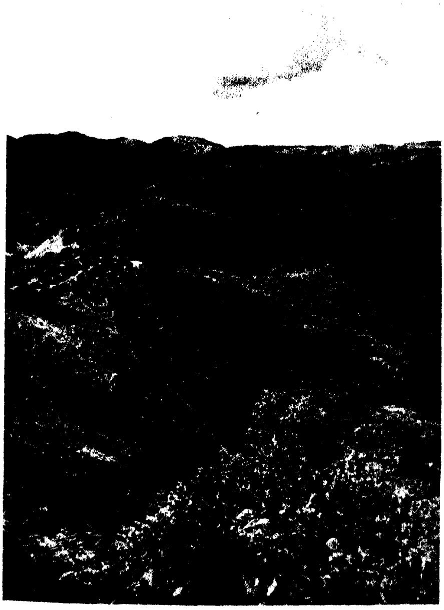
[3] See especially E. A. Bernard and N. B. P. Vander Elst: L'organisation nouvelle du réseau et des recherches météorologiques au Congo belge, *Bull. Agric. du Congo Belge,* Vol. 39, 1948, pp. 77–100; also several articles by A. Vandenplas in the *Bulletin Agricole du Congo Belge,* including the rainfall study "La pluie au Congo belge," Vol. 34, 1943, pp. 275–396; also his "La température au Congo belge," Ministère des Colonies, Brussels, 1947. See also Étienne Bernard: Le climat écologique de la Cuvette centrale congolaise, *Publs. Inst. Natl. pour l'Étude Agronomique du Congo Belge,* Brussels, 1945 (reviewed by V. Conrad, *Bull. Amer. Meteorol. Soc.,* Vol. 29, 1948, pp. 476–477; by M. Sanderson, *Ecology,* Vol. 30, 1949, pp. 265–269.

[4] *Science,* Sept. 17, 1948, p. 301; *Science News Letter,* Sept. 11, 1948, p. 167; *Nature,* Apr. 2, 1949, p. 543. The director, Dr. Louis van den Berghe of the Institute of Tropical Medicine, Antwerp, is already established at Costermansville; J.-P. Harroy is secretary-general of the administrative services in Brussels.



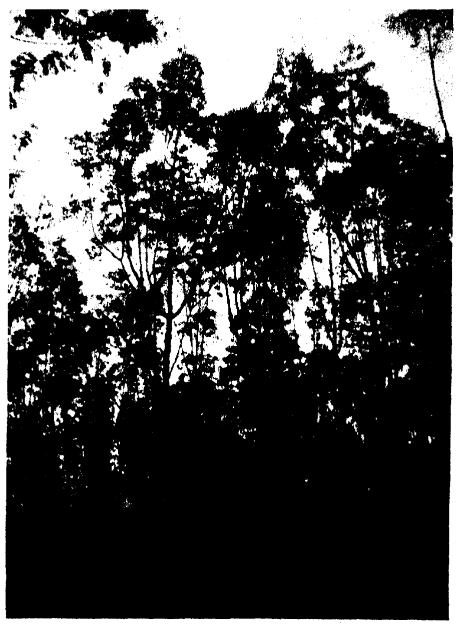


FIG. 10—Bananas for export growing as an under-story in heavily thinned-out rain forest 25 miles north of Boma.

FIG. 11—Looking northwest from a point about 8 miles west of the Great Rift Valley escarpment Kivu Province. Village on ridge with cultivated fields and various stages of regrowth forest. Altitude 5000 feet.

FIG. 12—Second growth, predominantly *Musanga Smithii* about 60 miles southwest of Irumu. Sweet potatoes on the spoil banks at the edge of the road. Altitude 2000 feet.

FIG. 13—*Cinchona ledgeriana* for quinine planted in 1931 from Javanese seed. Mulungu Experiment Station, about 10 miles west of Lake Kivu. Altitude 5500 feet.

men clear the land for planting and do the hunting; the women plant, tend, and harvest the crops and prepare the food. The wife is bought, and if the husband prospers, he may buy a second wife, to have more labor for more food production. Manioc, maize, sweet potatoes, peanuts, upland rice, beans, cucurbits, and other crops are raised, often several different ones simultaneously in the same clearing. In most parts of the lowlands oil palms (*Elaeis*) are grown for the oils; manioc and other young leaves cooked in palm-pericarp oil are an important accessory food. From hunting the natives obtain considerable meat, but the quantity in the diet is often inadequate. Servants of European families have been known to kill their masters' dogs because they were jealous of the meat-fed pets.

Customs differ from tribe to tribe, but in general the Blacks in their villages are communal-minded. They share what they have; or perhaps it is better said that if one person is fortunate enough to have an abundance of food, the others help him eat it. It was explained to me that in introducing new methods of agriculture it would be necessary to help the entire village or clan; it would not do to follow the Uganda practice of training only one young man in a community to be a better farmer, for his relatives and connections would expect him to share his crop with all of them. If he did not, he would certainly be poisoned. Extremely potent poisons are obtained from forest plants and are regularly used for poisoning hunting arrows and spears. Witchcraft in many forms plays a large part in the life of the Blacks and combined with powerful poisons is responsible for many deaths. Administrative officers and employers continue to learn of deaths explainable in no other way.

Life in the forest made for sharp sight and hearing. An example of the way in which these faculties are put to good use is to be seen in the traffic-control system employed on the narrow, dangerous mountain road between the Ruzizi Valley and Costermansville (Bukavu), on Lake Kivu. Messages are sent from ridgetop to ridgetop by pounding on an oil drum, and by the use of spherical signals, a foot in diameter, hoisted at the signal stations. The control of the heavy automobile and truck traffic on this road is perfect: since its opening some 15 years ago not an accident has occurred because of failure of this unique communication system. The signaling is sufficiently clear and definite to cope with breakdowns of vehicles and even reversal of traffic within a block (Fig. 29).

Fighting was more or less continuous between the tribes, and even between smaller groups; head-hunting and cannibalism were common. Now that the Belgians severely punish tribal warfare, there is free movement and

safety for all. In the Lower Congo, *Mbote,* meaning "All quiet ahead," is the usual greeting. Recently members of one of the last cannibal tribes were employed as laborers at one of the agricultural experiment stations; up to the time of my visit nothing untoward had happened, nor was there any reason to believe that the Black laborers of other tribes at this experiment station were worried. But this safety and the resulting freedom of movement have been disadvantageous to health, in that diseases have been spread far and wide.

As seen on the roads, the Blacks are apt to be solemn and severe, even fierce in appearance, for they usually carry a large spear or bows and arrows, and the tribal headgear is decked out with feathers or monkey hair. But a remark or the greeting "Mbote!"— or "Yambo!" in the east—will be answered with a quick smile. In fact, the Blacks are both lovable and loyal. Europeans of long residence in the Congo have told me how on more than one occasion a Black servant has unhesitatingly risked his life to save his master.

In these human resources there has been great change. The Mohammedan Arabs, centuries ago, penetrated for several hundred miles into the north and east of what is now the Belgian Congo, mainly for slaves and trading. Their polygamy fitted in well with the local practices. Kiswahili, the lingua franca of the eastern Congo, is a result of the presence of the Arabs. In parts of the Uélé the faces and bearing of the ruling Azandi chiefs clearly indicate their Arab descent. In upper Ituri, northeast of Bunia, is a tribe in which many of the older women (*femmes de plateau*) have their lips stretched out two to three inches and deformed, reputedly to make them unacceptable in the harems of the Arabs. The danger no longer exists; hence the practice has not been continued with the younger women.

All too effectively, the early Christian missionaries instilled the idea that everything connected with the native's preconversion life should be discarded. The younger generation has scant respect for the forest lore of its elders or for the accumulated wisdom expressed in the wealth of proverbs, which are most effective and conclusive in conveying ideas with an indisputable meaning and finality. Nor is there enough respect for the parents or the local chief or headman. After learning to read and write a bit at the mission school, and with a "part" shaved in their closely cropped kinky hair and some Western clothing, the young natives are virtually detribalized.

About 1491, Portuguese colonists, accompanied by Roman Catholic priests, came up the Congo about 50 miles to the rapids and thence penetrated southeastward by land perhaps as much farther. It is believed that they brought with them manioc, *Manihot utilissima,* now the most important food

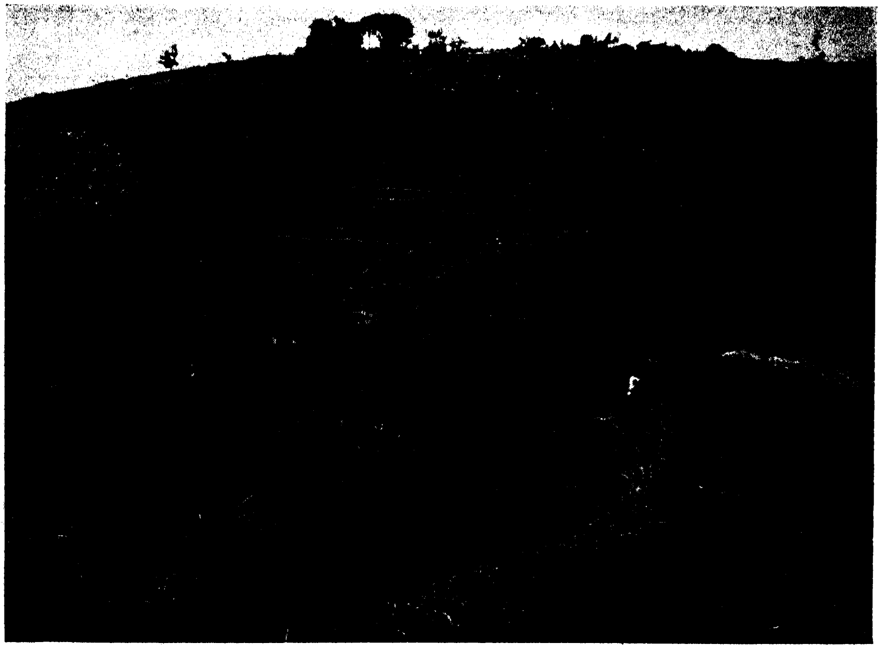


FIG. 14—Trimming terrace-edge hedges of *Pennisetum purpureum*: Luhoto Experiment Station, on the equator, altitude over 6000 feet. Between Butembo and Lubero. Farmstead above, with groups of banana plants.

FIG. 15—Native cultivation of beans on left; European-grown pyrethrum on right. Volcanic region 15 miles northeast of Lake Kivu. Altitude over 5000 feet.

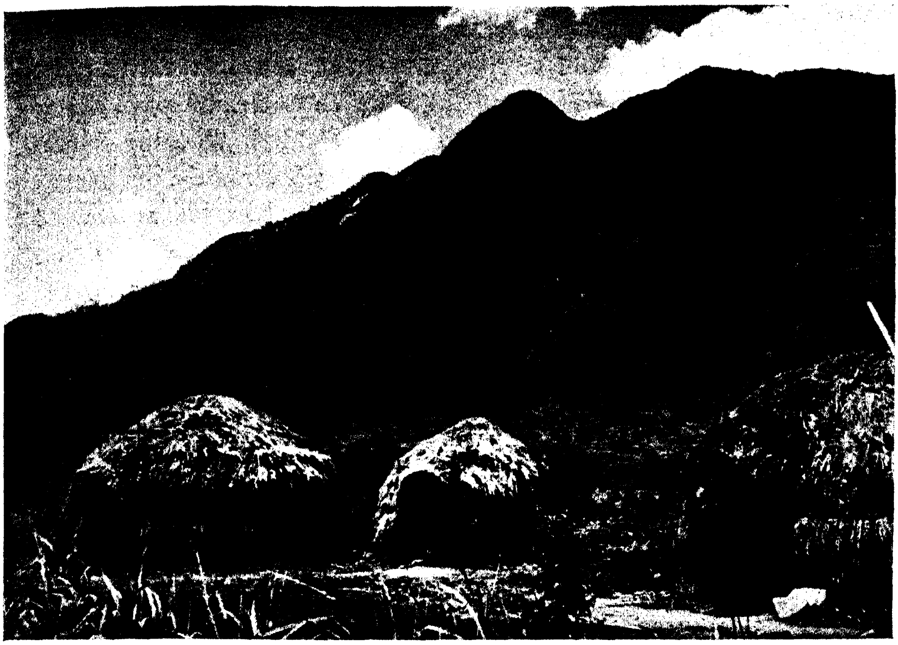


FIG. 16—Mt. Abusendo, western escarpment of the Great Rift Valley from a point on the floor at an elevation of about 2800 feet, 15 miles south of Ruindi, south of Lake Edward. Huts of cogon grass. Low-rainfall region.

FIG. 17—Laborers on the Mulungu Experiment Station prefer their native-type hut of poles and leaves to the ones made of bricks and mortar. Altitude about 6700 feet. Kivu Province.

for all the western Congo. This Portuguese colony, now known as Angola, south of the mouth of the Congo, and tiny Cabinda, to the northwest, almost completely shut the Belgian Congo off from the sea. Especially in the western Congo, Portuguese traders continue to be a major factor in the commercial life. Being willing to begin in a small way and to work hard, they own and operate most of the smaller shops. As one Belgian expressed it, the Portuguese trader is willing to sleep on the counter of his shop for a few years, until he has accumulated enough capital to build himself a separate residence. Thus the Portuguese play a similar part to that of the Chinese in Southeast Asia, even to being accused frequently of sharp practices and dishonest dealings with the Blacks. The Belgian district administrators have to be continually on the alert to protect the Blacks against these traders. One informant related a conversation he had overhead between one such trader and a Black boy who wanted to buy a fishhook. The reply was that the fishhooks were not for sale, but if he would bring his sister to the trader, he could have one.

FIG. 18—The Forescom Building, which houses the offices of many commercial firms. Léopoldville, capital of the Belgian Congo.

In the Katanga the commercial and hotel operators are more often Greeks and Rhodian Jews; in the northeast Arabs are still important in trade. Only a few Indian traders, emigrants from India, were noted, and these only in the extreme east.

Mineral Developments

In contrast with the agricultural heart of the Congo are the mineral industries of the rim, especially in the south.[5] The Belgian Compagnie du

[5] The classic reference is Maurice Robert: Le Congo physique, Brussels, 1923; 2nd edit., Brussels, 1942; 3rd edit., Liége, 1946. See also his "Le Katanga physique," Brussels, 1927; also his numerous other publications under the auspices of the Comité Spécial du Katanga. A useful review with statistics up to 1945 is "Mineral Resources of the Belgian Congo and Ruanda-Urundi," prepared by Maxine Colonna and F. L. Fisher, *Foreign Minerals Survey*, U. S. Bur. of Mines, Vol. 2, No. 6, 1947. See also L. Anciaux: Coup d'œil sur l'évolution de l'économie minière et agricole du Congo belge, *Acta Tropica*, Vol. 4, 1947, pp. 241–258 and 312–334.

Katanga was founded in 1891 to exploit the mineral deposits of the Katanga.[6] A few years later the Comité Spécial du Katanga (CSK) was organized to administer as trustee the domain under the Compagnie du Katanga. At the same time the British Tanganyika Concessions Limited (TCL) was exploring on the Rhodesian border of the Katanga. In 1906 the two organizations formed the Union Minière du Haut-Katanga (UMHK). Joint activity of the British Rhodesian mining interests and the Belgian UMHK is apparently still important. Between 1900 and 1910 the Katanga wavered between Belgian influence endeavoring to keep it attached to the rest of the colony and British and South African influence. Elisabethville was established near the then fabulously rich copper mine, the Étoile, as an outpost against British encroachment. In 1910 the railroad from South Africa reached Elisabethville. Later, the completion of the Belgian Congo railroad northwest a thousand miles to Port Francqui, connected by a fortnightly steamer with Léopoldville, and of the railroad westward over the high plateaus of Angola to Lobito and the development of exceedingly rich mineral deposits west and northwest of Elisabethville gave hopes for the setting up of a capital for the Katanga in a more appropriate locality;[7] but Elisabethville (Fig. 30) remains the second-largest and most Europeanized town in the Congo, with a population of some 70,000, of whom nearly one-tenth are white.

FIG. 19—Memorial in bronze and red sandstone to King Albert. The unusual flanking bronze screens depict agriculture and public health. Léopoldville.

The CSK retains its control over land titles and leases, prospecting and mining, and forests, and only recently did it transfer control of the agricultural experiment stations in the Katanga to INÉAC. From time to time

[6] In 1887, Captain Albert Thys founded the Compagnie du Congo pour le Commerce et l'Industrie (CCCI). The early and notable work of this company was the construction of the Matadi-Léopoldville railroad around the rapids of the lower Congo. The Compagnie du Katanga was organized by the CCCI.

[7] G. Delevoy: La question forestière au Katanga (Publ. Comité Spécial du Katanga), 3 vols., Brussels, 1928–1929.

complaints appear in the press that the analogous Comité National du Kivu is an anachronism and should relinquish all its functions to the government, particularly the control of lands and colonization. The third large land-grant organization, the Compagnie des Chemins de Fer du Congo Supérieur aux Grands Lacs Africains, has also gradually relinquished some of its functions to the governmental transport corporation OTRACO (Office d'Exploitation des Transports Coloniaux au Congo), which operates the main river and lake steamer lines and the Matadi-Léopoldville railroad.

Four Belgian financial groups and one British group have provided most of the private capital that has made possible the development of the colony. It would be interesting, but impossible in the space available, to give an idea of the complexity of their structure; many of the more important trading houses, mining and transport companies, and banks and other firms are interrelated through interlocking directorates and financial controls.[8] In many enterprises the state is an important shareholder, and OTRACO is owned by the government. The concentration of the palm-oil business in the hands of the Lever interests, for example, is definitely monopolistic, and the same thing can be said of other activities, but in view of governmental participation and control, the results are not considered to be harmful. Government-owned public services of electricity, water power, and transportation are generally operated as private companies rather than as governmental municipal activities.

Water and Rail Transportation

Transportation facilities in the Belgian Congo are far ahead of those in the Amazon Valley, the most closely comparable region in low latitudes. The Congo with its principal tributaries offers a remarkable system of channels, and the river is unique in having a relatively slight difference between high and low water, a result of the alternating rainy seasons in the northern and southern parts of the drainage basin, which lie on opposite sides of the equator. But the rapids in the lower course, beginning about 50 miles up from the Atlantic, the falls a thousand miles farther upstream at Stanleyville, and the falls and rapids in a number of the tributaries necessitate rail portages and transshipment of freight. Moreover, the very slight fall in the main reaches of the river and its tributaries and the consequent silting and shifting of sand bars make navigation difficult; 1.7 meters is the maxi-

[8] A succinct statement by a former colonial minister is Robert Godding: Developments in the Administration of the Belgian Congo, *in* Colonial Administration by European Powers, by José de Almada and others, Royal Institute of International Affairs, London and New York, 1947, pp. 40–67.

FIG. 20—Matadi, at the head of navigation for ocean-going steamers about 50 miles up the Congo River from the Atlantic Ocean.

FIG. 21—The Matadi—Léopoldville Railway was rebuilt recently. The stations are neat and attractive. Lower Congo.

FIG. 22—Main highway 150 miles east of Stanleyville toward Ituri, west of Avakubi in a sandstorm country. Scattering Elaeis palms and relic trees. Altitude 1500 feet.

mum draft for much of the way. The channel, though broad, is cluttered with numerous wooded islands and sandbanks, so that any power craft must take almost continuous soundings with calibrated poles. Three survey and channel-marking boats are always at work sounding and charting the shifting channel bottom of this 1000-mile stretch.

Although railroads have been built round a number of the rapids, transshipment causes serious delays. In 1948 the railroad was four to six months late in getting goods from the wharves at Matadi to Léopoldville, 225 miles upstream. Here further delays occur before shipments can start up the river. Goods must also be transshipped at Stanleyville, at Ponthierville, at Kindu, and at Albertville. If they are going on to Goma, there are also transshipping points at Uvira, Kamaniola, and Costermansville. Because of the Matadi, Léo, and Port Francqui transshipment delays, much of the freight traffic between Elisabethville and foreign countries goes by rail over the highlands of Angola to the Portuguese port of Lobito. Recently mention has been made of proposed railroad lines between Stanleyville and Goma, with a connection to Uganda via Kampala, and between Kamina and Kabalo and of the closing of the gap between Léopoldville and Port Francqui. A new route to the Indian Ocean is proposed, from Ndola or Broken Hill, Northern Rhodesia, to Tabora, Tanganyika, and Dar es Salaam, and/or around the north end of Lake Nyasa and east to Lindi (see Fig. 1).

Some of the freight for the Kivu region enters Africa via Dar es Salaam and moves by rail to Kigoma, by steamer to Uvira, by rail to Kamaniola, and by truck over the mountains to Lake Kivu. For the extreme northeastern part of the country a small amount (possibly 5 per cent) of freight from Europe comes to Port Sudan, on the Red Sea, and moves by rail to Khartoum, by steamer up the Nile to Juba, and by truck into the Congo at Aba.

Roads and Road Construction

For a large tropical country with a relatively sparse population and in most parts a lack of durable surfacing material, the Belgian Congo has an amazing network of good roads, motorable practically all the year. Simple but sound principles of construction have been followed. Since most of the soils are mature, with a relatively light-textured surface soil a foot or two deep, this is removed. The subsoil is then crowned up well, and capacious drains are dug out from the road, so that drainage of rain water is adequately provided for. Every mile or oftener in most of the basin, irregular ferruginous concretions locally known as "limonite" can be excavated and used for a thin surfacing. In the absence of such "gravels," the gray earth-organic mixture

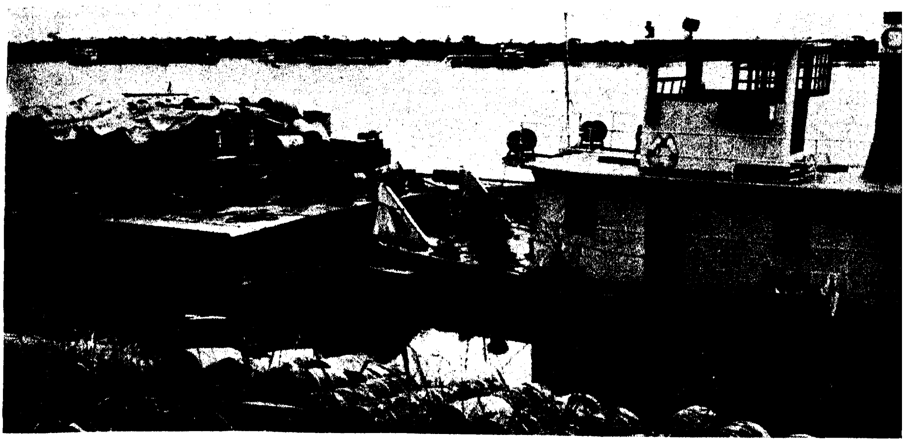


FIG. 23—New pusher-type river boat with barge. In the distance loaded barges being towed down the Congo River. Yangambi, about 50 miles northwest of Stanleyville.

FIG. 24—Ferry across the Ituri River near Avakubi, about 200 miles east of Stanleyville.

FIG. 25—Citrus orchard interplanted with *Mimosa invisa* and cassava. Note the large termitarium. East central Congo. Altitude 1400 feet.

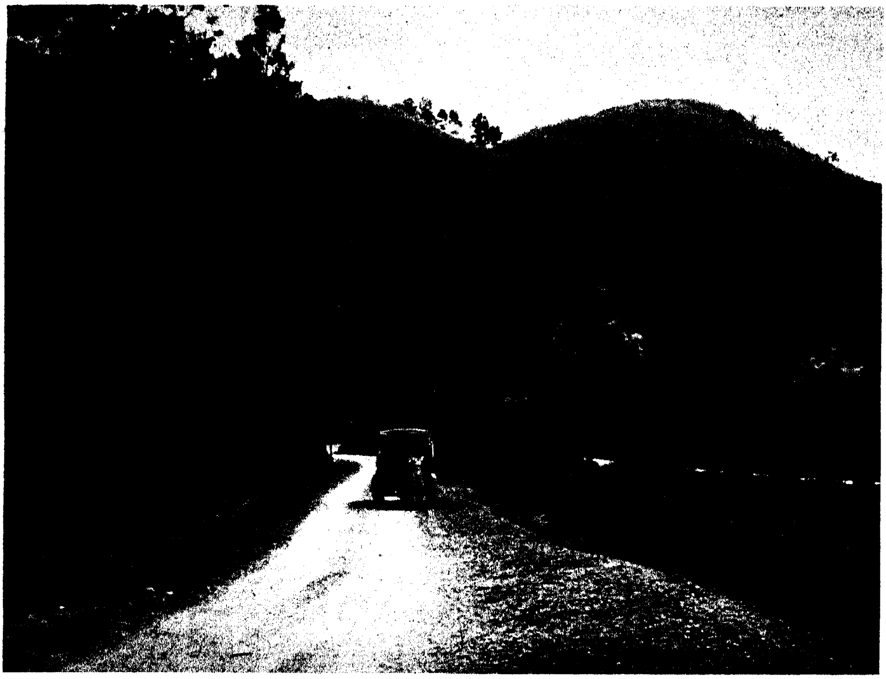


FIG. 26—*Podocarpus* as roadside trees, wattle (*Acacia*) plantings above to left. Most of slopes covered with tall grass and regrowth brush. Altitude about 6000 feet. North of Lubero, west of Lake Edward.

FIG. 27—Looking west along the northern end of Lake Kivu. Summer homes on peninsulas formed by old lava flows. Eucalypts abundant. Altitude about 4600 feet. Kisenyi, Ruanda Urundi.

FIG. 28—Looking west across the southern end of Lake Kivu. Nyalukemba at the left, Costermansville beyond. Open plantings near are eucalypts; lower, denser plantings are cinchona. Altitude of lake 4800 feet.

FIG. 29—Highway signalman, his camp, and semaphore on a hilltop along the road between Lake Kivu and the Ruzizi Valley.

from certain types of termitaria is used. For main roads with considerable truck traffic, a base of laterite chunks is placed on the crowned-up subsoil and surfaced with the same sort of concretionary "gravels."[9]

Except in rare cases, roads are built and maintained by hand. Main roads are kept up by regularly hired gangs (*cantonniers*) at the rate of one man to a kilometer. Very few of the wide rivers are bridged; most of them are crossed by a hand-propelled ferry, a deck built over a series of dugout canoes, which can usually carry two cars or trucks at a time.

The construction of roads has been pushed by the government especially to facilitate movement of the administrators and to get out agricultural products. The government rightly insists that its officials move about frequently and widely in their districts, not only to ensure law and order, but to see to the production of the required crops. Until recently it was obligatory for all native men not regularly employed to work on the roads for a certain number of days a year. To avoid this and other obligations, many Blacks got regular jobs on plantations or in mines or other industrial undertakings. At times, when they could not get such jobs, some hid in the forest, with man-traps and other devices to prevent their being caught by the police. To facilitate the collection of taxes and the production of the required crops, many of the rural natives have been compelled to move out of the forest and establish their houses in neat groups close along the roads. Instead of working on the roads, natives now pay a head tax, which is given to the chiefs so that they can hire laborers. But the complaint is repeatedly heard that the chiefs compel their subjects to do the work but fail to pay their laborers.

"Educative" Agriculture

Compulsory agriculture is considered necessary to ensure the supply of food needed by the mines, the large towns, and government institutions such as prisons and hospitals. Foodstuffs must be produced under the supervision of the territorial administrators, assisted by the local extension agronomists, collected periodically, usually weekly, and trucked to the consuming centers. The government insists that the produce be paid for at official rates.

Control is well illustrated in the districts north and south of the central tropical rain forest where cotton is raised.[10] Different companies are given the monopoly for production, purchase, ginning, pressing, and shipping in

[9] For a discussion of road building in relation to local soils and road materials see E. Devroey: Contribution à l'étude des sols: La stabilisation des routes au Congo belge, *Bull. des Séances de l'Inst. Royal Colonial Belge,* Vol. 12, 1941, pp. 112–133.

[10] For details of its working see Edgar van der Straeten: L'agriculture et les industries agricoles au Congo belge, Compagnie du Congo pour le Commerce et l'Industrie, Brussels, 1945, pp. 241–262.

specified areas. The district agricultural extension officer assists the representatives of the cotton company in selecting the land to be cleared; usually a number of villagers are assigned plots together close beside a road. Every villager is required to plant, and inspections are made to ensure that the crop has been planted and is being cared for. Periodically throughout the picking season, the cotton is bought at specified places, in the presence of the Belgian representative. The cotton is weighed before him, and in the presence of the local chief. The amount purchased is entered in the villager's record, and he is immediately paid in cash the official price. About one-sixth of the cotton grown in the Congo, roughly 8000 tons, is spun and woven in Léopoldville; the rest is exported to Europe. The current price paid is less than the export price, but the difference is deposited in a fund that can be drawn on in years of lower prices to maintain a uniform price to the farmer.

As a wartime measure, in certain parts of the Congo thousands of small—perhaps half a hectare—plots of *Hevea* seedlings had to be planted by the villagers. These plots are now densely overgrown with brush and young trees and probably will never be tapped.

The official policy of compulsory planting is believed by the Belgians to be justified, not only because of the need for the products but because some activity for the men is necessary to take the place of fighting. And then, once the Black realizes that he will be paid for his crop and will have money to spend and goods in the shops to spend it on, thereafter, in many cases, he will want the money badly enough to raise the crop without compulsion. It is also argued that the Blacks always have plenty of time to spare, so that they can just as well as not raise the needed products. Each native must carry an "identity card," a small record book in which his employer must regularly note the length of employment and the amounts of wages paid, and also the value of the rations supplied weekly; for the government demands that every employer must supply certain quantities of different kinds of food weekly, and one pull-over sweater and one blanket at the beginning of service. This is because once the Black has learned what he can do with his money, he is apt to spend too much of it for other things than food, with detriment to himself and his work.

THE MISSIONS

Although Protestant missionaries from many countries have been active in the Congo since the days of Livingstone and average now about 1200 in the field and about 300 on furlough, in recent decades the Roman Catholic Church has occupied a privileged position as regards government support

FIG. 30—Elisabethville: European town in the foreground; main offices of the Union Minière in the grove of eucalypts along the Lubumbashi creek; Lubumbashi smelter at the upper left.

FIG. 31—Large termitarium near Elisabethville. The natural vegetation has been destroyed. Altitude about 3800 feet.

FIG. 32—The poor maize growth at the right is on the center of a former termitarium. Keyberg Experiment Station, about 10 miles southwest of Elisabethville. Altitude about 3800 feet.

FIG. 33—Forest opening ("dembo") with typical gray termitaria. Trees mostly *Brachystegia sp.* About 10 miles southwest of Elisabethville. Altitude about 3900 feet.

and subsidies, especially for educational activity. Many mission stations have large and imposing brick buildings; their physical plant is conspicuous. The educational program is shaped toward the training of priests, so that the emphasis tends to be on the classics and dogma, rather than on the practical. After the very best of the graduates have been selected for further ecclesiastical training, the others find employment as clerks in government offices, banks, railroads, commercial establishments, and so on.

Though the work of the Protestant missionaries has been less spectacular, one hears repeated testimony to the high character of their converts, even from Belgian Catholics. Within the past year the government has made it possible for Protestant mission schools to receive similar subsidies and recognition to those that the Roman Catholics have been receiving, provided the foreign missionaries engaged in the educational work have spent a year in Belgium studying the French language, cultural subjects, and the Belgian way of life, and that from time to time they take refresher courses in Belgium. It is understood that the government desires to keep education under the control of Christian missions, because it believes that this is the surest way of keeping Communism out of the schools.

During the last war the colony perforce had considerable autonomy, but again Brussels is asserting its authority. The development of modern air transport, with hardly 24 hours between Léopoldville and Brussels, of course facilitates this. Decisions on many matters, even seemingly small ones, are made in Brussels; most scientific and official reports are printed and published there—all in all, the reins seem to be held very firmly.

Belgian Settlers

Largely because of the war clouds hanging over Western Europe—and the Belgians have not forgotten the two invasions of their homeland—Belgians are moving to the Congo to live, bringing with them their treasured family possessions. Some even plan on educating their children in South Africa or in the United States, where they would not be so easily cut off from their parents in case of war. It should be noted that except for the small area near the mouth of the Congo River all the basin is more than 900 feet above sea level, and this means that fully tropical lowland temperatures and discomfort do not prevail. In the eastern mountains the elevations are much greater, so that the climate is relatively comfortable. But even in the lowlands the Europeans build their residences much as they do in Belgium; hence they are usually far from being suited to conditions.

This movement has an agricultural basis. There is great pressure from

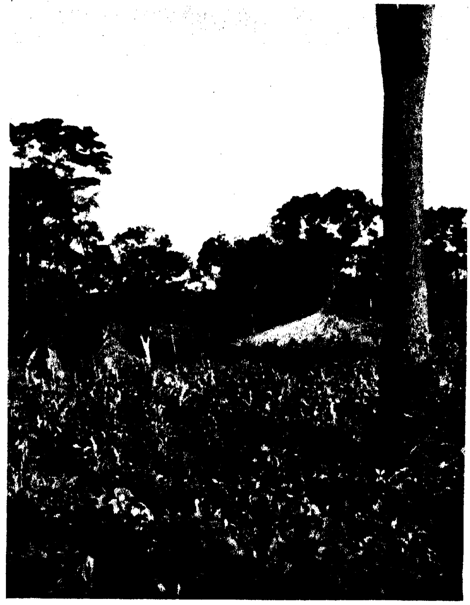


FIG. 34—A Hollander, with long tobacco-growing experience in Sumatra, is producing sumatra-type wrapper tobacco on the Cobelkat colonization project, Kaniyama, Lomami. Altitude 3000 feet.

FIG. 35—The local method of digging out cogon grass with a short-handled hoe, preparatory to planting maize and cassava. Gandajika, Lomami. Altitude 2600 feet.

FIG. 36—Gallery forest partially cleared and burned to plant the maize and beans. Tree at right girdled to kill it; farmer's hut beyond. Near Luputa, Lomami. Altitude 2800 feet.

FIG. 37—Reforestation trials on former fire-climax savanna at Kaniyama, Lomami. Altitude 2900 feet. Fire prevention combined with planting of soft and hardwood trees gives good young forest.

Belgium to admit more agricultural colonists to the Congo, but the colonial government is conservative in the matter. Cobelkat (Congo Belge Katanga), one of the best colonization schemes, accepted 10 families last year and expects to accept 15 this year and 20 next year. It selects not more than 10 per cent of the applicants; for its methods of checking character and suitability in the

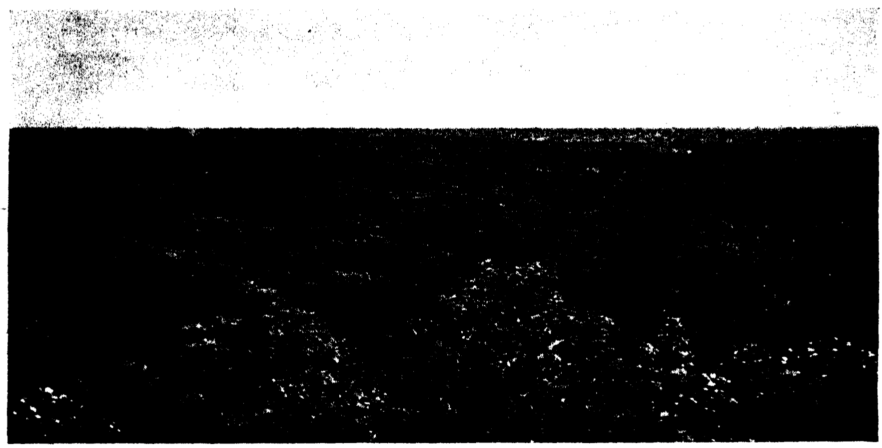


FIG. 38—The forest along the Katanga—Rhodesian boundary from the railway. Altitude about 4000 feet.

applicant's native Belgian community are thorough and rigorous. Moreover, each colonist must make a heavy deposit in Belgium to cover his return ticket in case he does not make good. The government is determined to prevent the development of a poor-white community. Another reason for conservatism in colonizing with whites is that each *colon* will really be the proprietor of an estate of some hundreds of acres, for which he will need much native labor. The authorities are reluctant to permit a further draft on labor now producing food and cotton after 700,000 have gone to rubber and palm plantations and to the mines. Furthermore, the authorities desire to disturb the fabric of native rural life as little as possible, so that, in the event of an economic crisis, when most of the mines and plantations would almost certainly have to shut down, the laborers could return quickly and easily to their villages and to food production. It should also be noted that land available for colonization is limited, and so is the supply of available labor.

The colonists do not and cannot specialize in the cultivation of ordinary field crops; they concentrate on special products—cinchona, pyrethrum, dairy products, or meat—for the mines and other special markets. Some of the larger mining companies have their own farms also, especially for the production of meat and dairy products.

Administration

The Congo is divided into some 120 *territoires*, the basic administrative unit. These are grouped into districts, and the districts into six provinces. The governor general and his central government for the Belgian Congo are located in Léopoldville. In any colonial government the nature of the ad-

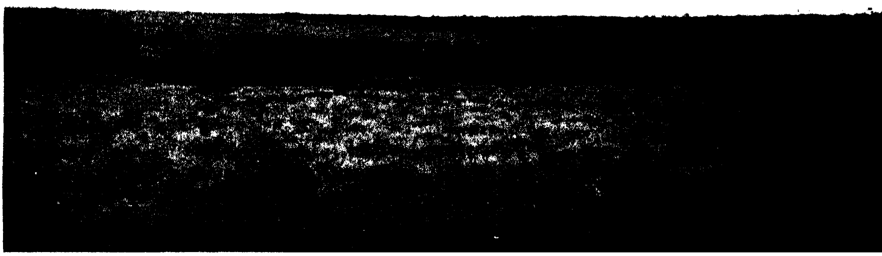


Fig. 39—Fire-climax savanna on the plateau northwest of Kamina, Lomami, southern Congo. Low mounds of old termitaria visible against the gallery forest along the creek.

ministrative machinery is important, but of much more importance is the character of the officials who deal directly with the natives to see that justice is done. This is especially the case in the Congo, where so much obligatory work is required of the natives,[11] and where they are in some ways very "primitive" and docile.[12]

From those who have had frequent dealings through the years with *administrateurs de territoire* one gets the impression that as a whole they are a superior group, serious, well trained, and genuinely attached to the Blacks, and that in spite of growing demands from the central government to submit increasing numbers of reports they work hard at their job. During the war the insistence on producing larger quantities of more kinds of agricultural products necessitated more pressure on the villagers to turn in their quotas. Then there were further causes of stress.[13] Compounded of a lack of home

[11] An informative comparison of methods in French Equatorial Africa and in the Belgian Congo is given by J. Dresch: Méthodes coloniales au Congo belge et en Afrique équatoriale française, *Politique Étrangère*, Vol. 12, 1947, pp. 77–89.

[12] See a review of René Tonnoir's "Le crépuscule des ancêtres" under the title "Le rôle des administrateurs de territoire," *Le Courrier d'Afrique*, Léopoldville, Feb. 3, 1949.

[13] Such as that of the "American occupation" of the port and main towns during World War II. In the "bush" this was interpreted by the Blacks to be an invasion of American Negro soldiers to liberate them from all obligations to the Belgians!

leave and other shortages, the war difficulties left their mark on this civil service. It is generally recognized that for a time the new administrators were not always of as high a standard as before. Some apparently felt that the new broom must sweep, and sweep clean; one new administrator, for example, very unwisely insisted on having all the oil palms cut along 50 miles of highway.

It is wise to maintain the native tribal organization as much as possible, provided the local chief is able and interested. But certain administrators who, because of lack of tact or patience, were unable to work through the local chiefs had them exiled by the provincial government and replaced by "yes men." In other cases the Blacks, in order to avoid having to comply fully with the rulings and desires of more severe administrators, put up dummy chiefs, who would take the orders and rebuffs of the administration but would not pass them on to the community.

For the most part such times are over. Administrators have been thoroughly studying tribal and family organization. In the Bambesa portion of Buta territory they are helping to reconstitute the clans and smaller groups of the Babuas preparatory to resettling them in a *paysannat* scheme that is one of the finest pieces of rural reconstruction I have ever seen. In this one scheme alone more than 19,000 families have been resettled by clans and are being helped to apply practical crop-rotation methods; they are planting higher-yielding and better-quality crops and following cultivation methods that have been developed by the agricultural scientists of the Bambesa INÉAC experiment station. Small, appropriate community centers for social, commercial, and public-health activities are being established in cooperation with the missionary organizations.

These are some of the things I have seen in the Congo or have heard from those long resident there; they indicate trends in the development of a remarkable colony.[14] The Belgians and their associates deserve great credit. Because of their relatively late start, they are able to avoid many of the pitfalls that have brought such unhappy results in the colonies of other European governments.

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[14] Part IV of Tom Marvel's "The New Congo" (Duell, Sloan & Pearce, New York, 1948), discussing the tasks ahead in the colony, is well worth attention. A French translation of Marvel's book, under the title "Le nouveau Congo," with many half-tone illustrations, has been published in Brussels.

AOTEAROA MAORI: NEW ZEALAND ABOUT 1780

KENNETH B. CUMBERLAND

THE quality of any habitat can be satisfactorily appraised only in the light of a knowledge of the particular group inhabiting it at a particular time. As the habit of the group changes, or as a different group irrupts into the habitat, its potentialities and promise are transformed; after every advance in the culture of its occupants and every change of occupancy its resources must be re-evaluated.

Less than two centuries ago New Zealand was in the undisturbed and undisputed possession of a human group with a neolithic culture. A little more than a century ago the full flood of European culture reached its surf-fringed shores and soon flowed deeply over the land; in the last few decades the skills, technology, and proficiency of this immigrant culture have advanced at an unparalleled rate. The Maori revered the forest and protected it with elaborate and all-embracing restraints, and he prized nephrite—the jade-green stone from which he fashioned his weapons—above all other mineral resources; the invader, however, found the dull green bush a barrier to his pastoral progress, but he set store by the black stone he called coal. To the two cultures the New Zealand habitat meant different things; each set a different assessment on the same materials.

The point of view adopted in this study in historical geography is chorological, not chronological. It is an attempt to describe the "existence together" of phenomena, both physical and cultural, to interpret the character of the geographical regions of New Zealand at a particular period of time, and to re-create its "atmosphere." Maori occupance of Aotearoa is here considered to have been at its most representative stage of development in the generation after it was first examined by Cook and his shipmates in 1769. Maori culture has had its eminent students, and there is a wealth of published material on which the historical geographer can draw. But he is not restricted to historical records; an investigation of Maori geography of the past can utilize direct field observation and many of the techniques that would be employed in a survey of the geography of the contemporary period. The present study contributes little that is factually new, but its application to old material of a point of view not hitherto brought to bear

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on that rich source of information may enlarge the understanding of a most interesting culture and the equally interesting terrain it occupied.

The ethnic and regional origins of the Polynesians or of their predecessors in the New Zealand islands need not concern us here. It is significant, however, that the Maori reached Aotearoa from "Hawaiki" in the middle of the fourteenth century, by following the ocean routes pioneered by Polynesian Columbuses centuries before Columbus himself crossed the Atlantic. Possibly 800 bold pioneers, men, women, and children, took part in the great migration, and although there may well have been earlier arrivals, the traditions of the Maori people go back to the *waka* that made up the fleet of this time, and their genealogy is traced back to the courageous crews of these canoes, the names of which are mirrored in social organization and continually occur in Maori song and story. It is significant also that, no matter what its precise oceanic location, the insular home of these seafaring migrants lay in lower latitudes, and that the kinsmen of the Maori were essentially agriculturists and cultivators of tropical and subtropical crops in climates completely free from frost and warmer than any Aotearoa had to offer.

The Maori People

Despite ethnic variations and the fact that the scattered tribes of remote and isolated districts of Te Waka a Maui (the South Island)[1] seem to have been of smaller stature, inferior intellect and worth, and darker hue, the vast majority of the Maori people were tall, well built, and of light-brown color. Both men and women were strong and energetic. Hunting, war, and games developed strength, speed, agility, and endurance; and all of these were cultivated because of the social approbation they brought. Unless prevented by *tapu*, women shared the toils and burdens, in the fields, in the forest, and in the settlement; they sometimes accompanied warriors in the fight. Before his social life was tainted by early European contacts, the Maori belied the generalization regarding the indolence of "savages."[2] He was a hard worker and a hard fighter. His physique and health might well have been the envy of the European peasant of the time. Yet neither hard work nor hard fighting was demanded by an uncompromising environ-

[1] In accordance with the aim of this paper, Maori place names of the time have been used. Early explorers adopted Maori names for the three islands of New Zealand that the Maori themselves applied only to parts of those islands. Here the suggestion of Johannes Andersen (Maori Place-Names, *Memoirs Polynesian Soc.*, Vol. 20, Wellington, 1942, pp. 118–119) is followed, and the names *Te Ika a Maui* (Maui's Fish), *Te Waka a Maui* (Maui's Canoe), and *Te Punga a Maui* (Maui's Anchor) are used for the North, the South, and Stewart Islands respectively.

[2] See Raymond Firth: Primitive Economics of the New Zealand Maori, London, 1929.

ment, as some theorists have suggested; both owed more to social habits, cultural traditions, spiritual laws, and tapu. It is true that on arrival in Aotearoa the Maori found it necessary to adjust his way of life. But he brought an agricultural tradition and certain of his accustomed food plants, and he found ways of growing these in climates that were not the best for them. He evolved new and better-suited strains. He remained an agriculturist, but to a greater extent than before he became an expert hunter, gatherer, and fisherman. For all his Stone Age culture, the Maori was mentally active, intelligent, and highly adaptable and no abject tool of his new environment.

The Maori had been in undisturbed occupation of Aotearoa for more than 400 years when Cook came to chart the shores of the islands and to gather the information by which he later publicized the country and its people in Europe. Cook was followed by other explorers, by whalers and sealers, by traders and escaped convicts; and although permanent European settlement was still negligible at the close of the century, the cumulative effect of the new culture contact—of European firearms, diseases, trade, crops, and ideas—had begun to disrupt the traditional way of life of the more accessible tribes. In the sections that follow, an attempt is made to reconstruct the human geography of Aotearoa within the generation after Cook's voyages, before it had become adulterated by these influences. Contemporary records are few, and reliance must necessarily be placed on information collected after the turn of the century; fortunately, the Maori, through his established tradition of handing on the lore and history of his tribe and people directly, was able to give the early European historians and scientists reliable accounts of the character of different places in Aotearoa at different times.

Crops and Cultivation

Wherever he was able to cultivate successfully one or more of the 70 or 80 varieties of *kumara* (sweet potato, *Ipomoea batatas*) that he had introduced from the isles and islets of the tropical Pacific or managed to evolve in the manifold climates and soils of Aotearoa, the Maori was primarily a gardener or horticulturist, able to follow in modified fashion the agricultural traditions he had brought from Hawaiki.[3] This was the case with all the tribes of Te Ika a Maui (the North Island) except only the Tuhoe, inhabit-

[3] The outstanding authority on Maori agriculture, crops, and methods of cultivation is Elsdon Best. See especially his "Maori Agriculture: The Cultivated Food Plants of the Natives of New Zealand, with Some Account of Native Methods of Agriculture, Its Ritual and Origin Myths," *New Zealand Dominion Museum Bull. No. 9*, Wellington, 1925.

ing the elevated fastnesses of the Urewera, and the Ngati Tuwharetoa people in their bleak, exposed habitat around Lake Taupo. But in Te Waka a Maui the kumara was cultivated successfully only on the bay-head alluvial flats of the extreme north and sporadically on warm soils near the east coast as far south as Kaiapohia (now Kaiapoi, North Canterbury), and a little beyond.[4]

Because of the narrow range of their cultivated crops, the Maori supplemented their horticultural products by fishing, fowling, and hunting and by gathering the fruits of forest trees and shrubs. The never numerous peoples of the southern part of Te Waka a Maui were primarily fishing folk, and, having no gardens to hold them to settled habitations during the growing season, they were much more nomadic. The line of demarcation between the agricultural and nonagricultural tribes—the southern limit of kumara cultivation—was in the late 1700's perhaps the most significant geographical boundary in the country, and it is of interest to discover that it coincides closely with the southern limit of Thornthwaite's mesothermal climates.

The Maori had only three crops of real significance, the kumara, the *taro* (*Colocasia antiquorum*), and the *hue* (*Lagenaria vulgaris*), a gourd, all of which he had brought from Hawaiki. Taro and hue had a more northern climatic limit than even the kumara, so that the success of the Maori as a horticulturist owed much to his cultural characteristics, and especially to his communal discipline, cooperative industry, and tribal organization and leadership. These are apparent in his methods of cultivation, his domestic crafts, his settlements, and the many monuments to his activities that thickly stud the landscape of those regions which he occupied in strength. Land for crops was carefully and deliberately chosen. The Maori had names for more than 30 different soil types.[5] For his kumara plantations he preferred a light alluvial soil; for his taro, a soil that was heavier and more retentive. Where such soils were not readily available, he did not necessarily shift his settlement but expended prodigious labor and much time to make the soils suitable.

Forest and scrub were sometimes burned to provide a site for fields, and

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[4] The southern limit of kumara cultivation is in doubt, but numerous writers put it about Banks Peninsula and Lake Ellesmere. See, for example, the following: H. Beattie: Traditions and Legends Collected from the Natives of Murihiku (Southland, New Zealand), Part VIII, *Journ. Polynesian Soc.*, Vol. 27, 1918, pp. 137–161, reference on p. 148; *idem:* Nature-Lore of the Southern Maori, *Trans. and Proc. New Zealand Inst.*, Vol. 52, 1920, pp. 53–77, reference on p. 67; F. Dunnage: Historic Outline of Canterbury Maoris, *in* Canterbury: Old and New, 1850–1900, Christchurch, n. d. (1900?), pp. 160–170, reference on p. 163; Edward Shortland: The Southern Districts of New Zealand, London, 1851, p. 244.

[5] Best, *op. cit.*, pp. 19–20. The soil types are named and briefly described.

the fertilizing value of the ash was fully appreciated. But the Maori's agriculture was not of the milpa type; he rarely shifted his cultivated plots, and he always returned to the old cultivations when their fertility had recovered. The soils of Aotearoa are predominantly heavy and clayey, and to lighten them for his principal cultivated staple, the Maori went to great trouble. He brought sand from the river bed or the seashore, sometimes over great distances, to mix with the clay, and hundreds of acres of once carefully cultivated land have today an artificial horizon many inches deep brought by the Maori in flax baskets. In many localities in the Waimea Valley (Nelson) are deep pits from which the Maori with primitive wooden scoops removed hundreds of tons of gravel to lighten and warm the soils.[6] Some of these pits occupy from three to ten acres and are from five to nine feet in depth. They bear witness not only to the industry of the Maori but also to the fact that he existed in greater numbers than some have suspected and that his existence was more permanent and stable, and less disturbed and warlike, than evidence based solely on the period from 1800 to 1840 would suggest.

The productivity of the thin soils derived from recent basic lavas and scoria and of the light pumiceous alluvial deposits in the north was also fully appreciated. In the interior of the Nga Puhi territories in the vicinity of Taiamai scores of thickly populated settlements were supported.[7] Every patch of thin soil between boulders was brought into use, and many acres were cleared of their rocky encumbrances; thousands of tons of rough scoria and angular lava blocks were carefully piled into mounds and walls to extend the cultivable area.

Maori tools were primitive indeed. Although they spelled tedious and heavy toil, they were wielded by pleasant and cooperative effort and sufficed to provide for the Maori's elementary needs in adequate volume. His agricultural implements were all fashioned of wood, usually of *manuka* or *maire* (*Olea* spp.). Most important of them was the *ko* or digging stick that Cook described as a "stout picket." It was no more than a strong rounded and sharply pointed stick, to which was usually lashed an intricately carved step or footrest. It was used for breaking the ground before planting. Since he did not turn the soil, the Maori used his spadelike wooden shovel or *hoto* only in building earthworks and other engineering tasks. Besides the ko, he

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[6] T. Rigg and J. A. Bruce: The Maori Gravel Soil of Waimea West, Nelson, New Zealand, *Journ. Polynesian Soc.*, Vol. 32, 1923, pp. 85–93.

[7] Best, *op. cit.*, pp. 62–64; and Augustus Earle: A Narrative of a Nine Months' Residence in New Zealand, in 1827, London, 1832.

employed on his garden plots little else than paddle-shaped tools for planting and cultivation, scrapers or scoops for heaping up soil into hills to take the seed tubers of the kumara, and grubbers, which he used both in agriculture and in obtaining fern root.

Methods of preparing the soil, of planting and cultivating the crop, and of harvesting it varied from tribe to tribe and from place to place, but all these tasks were hemmed round by sacred tapus, by elaborate ceremony, and by the interpretation of astronomical signs by *tohunga* and tribal chiefs. All were coöperative community tasks, though individual plots, and the crops to be obtained from them, were the care and reward of individual *whanau* (extended families). But whatever the methods employed, there was agreement among early observers as to the trim and tidy appearance of the cultivated fields of these neolithic cultivators and the abundance of the crops they produced. The agricultural landscapes of Aotearoa were restricted and fragmented, and the croplands were concentrated principally in the northern part of Te Ika a Maui, on the east and west coasts, and southward up the valley of the Waikato in the territories mainly of the Nga Puhi, Waikato, Ngati Whatua, Arawa, Taranaki, and Ngati Porou tribes. Where no favorable soils were available in the vicinity of the nucleated cluster of tribal dwellings that formed the settlement, the fields often lay at a considerable distance. The cultivated plots of the representative *hapu* or subtribal group most frequently totaled about fifty or a hundred acres, though in the territories of the Nga Puhi in the far north, on the isthmus between Waitemata and Manukau Harbours, and on the Taranaki coast larger settlements and crop acreages were found. Each kumara, taro, or hue field was divided into sections by stone indicators, crude walls, or pathways deepened by frequent treading, and the bright green of kumara runners, large, fleshy taro leaves, and yam or gourd plants formed a regular, geometric quincunx pattern. The fields were sometimes protected from the depredations of the *pukeko* or swamp hen and from the Maori rat by fences of upright stakes with long rails lashed across them; where southerly winds were troublesome, light brushwood windbreaks of manuka were frequently erected.

The kumara was the Maori's principal, most widespread, and most successful crop. Taro was next in importance, and then the gourd, which served as food only when young and tender and was used when ripe to provide drinking utensils and calabashes. The yam, *uwhikaho* or *uwhi* to the Maori and *Dioscorea alata* to the botanist, was the most restricted of the food crops of Aotearoa; although Cook and other early Europeans recorded its cultivation, it seems to have been at about its poleward limit even in the

north of Te Ika a Maui and to have been the first of the natives' cultivated plants to be replaced, for it is not mentioned after the end of the century.

The only other plants that the Maori cultivated late in the eighteenth century were the indigenous *Phormium tenax,* species of *Cordyline, aute* (the paper mulberry, *Broussonetia papyrifera*), and the *karaka* tree (*Corynocarpus laevigata*). The different species of *Cordyline,* or *ti,* were planted for their trunks or taproots, from the fibrous matter of which the Maori obtained an edible farina. Since the traditional horticultural economy of the Maori has been destroyed, two species of *Cordyline* have almost disappeared from Aotearoa. Cook reported "½ a dozen Cloth plants" in what he called the Bay of Islands in 1769. Aute was grown for its fruit and to furnish an occasional head ornament. It was apparently at its critical poleward limit in the northernmost part of Te Ika a Maui. Sensitive to climate, it was also sensitive to alien cultural influence and was one of the first cultivated plants of the Maori gardener to disappear with the invasion of European flora.

Forest and Other Resources

Although in some localities cultivation of the soil occupied a foremost place in the economy of the Maori, it was to the wildlife of forest, lake, swamp, river, and shallow coastal waters that the majority of the tribes turned for food. Thev looked also to the bush and the swamp for materials for clothing and shelter.[8] The question of access and rights to fishing grounds, fowling preserves, eeling sites, and forest resources was more often a cause of intertribal warfare than disputes over cultivable soil. To the Maori the forest trees were an elder branch of the great family of living things and akin to himself, since both were the offspring of *Tane.* The tapu with which the forest was guarded made the Maori a conservationist. Placatory rites had to be performed before a tribe could slay the offspring of Tane in order to make a canoe or construct a *whare runanga* and before they could trap and snare the wildlife of the bush. Reverence for the forest and its creatures was complete, and as a result it supported them in perpetuity. It was only with the infiltration of European commerce and with the sapping of traditional attitudes that the Maori became prodigal with the forest, burning it wholesale to plant the immigrant potato or destroying it for giant *kauri* and *kahikatea* spars to obtain muskets with which to kill his enemies more easily. Cruise[9] and Dieffenbach[10] are not the only observers to point to the

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[8] Elsdon Best: Forest Lore of the Maori, *Memoirs Polynesian Soc.,* Vol. 19, Wellington, 1942.

[9] R. A. Cruise: Journal of a Ten Months' Residence in New Zealand, London, 1823 (2nd edit., 1824).

[10] Ernest Dieffenbach: Travels in New Zealand, 2 vols., London, 1843. See especially Vol. 1, pp. 201, 207, and 227–228.

extent and seriousness of the reversal of the Maori's attitude toward his thitherto primary resources after the turn of the century.

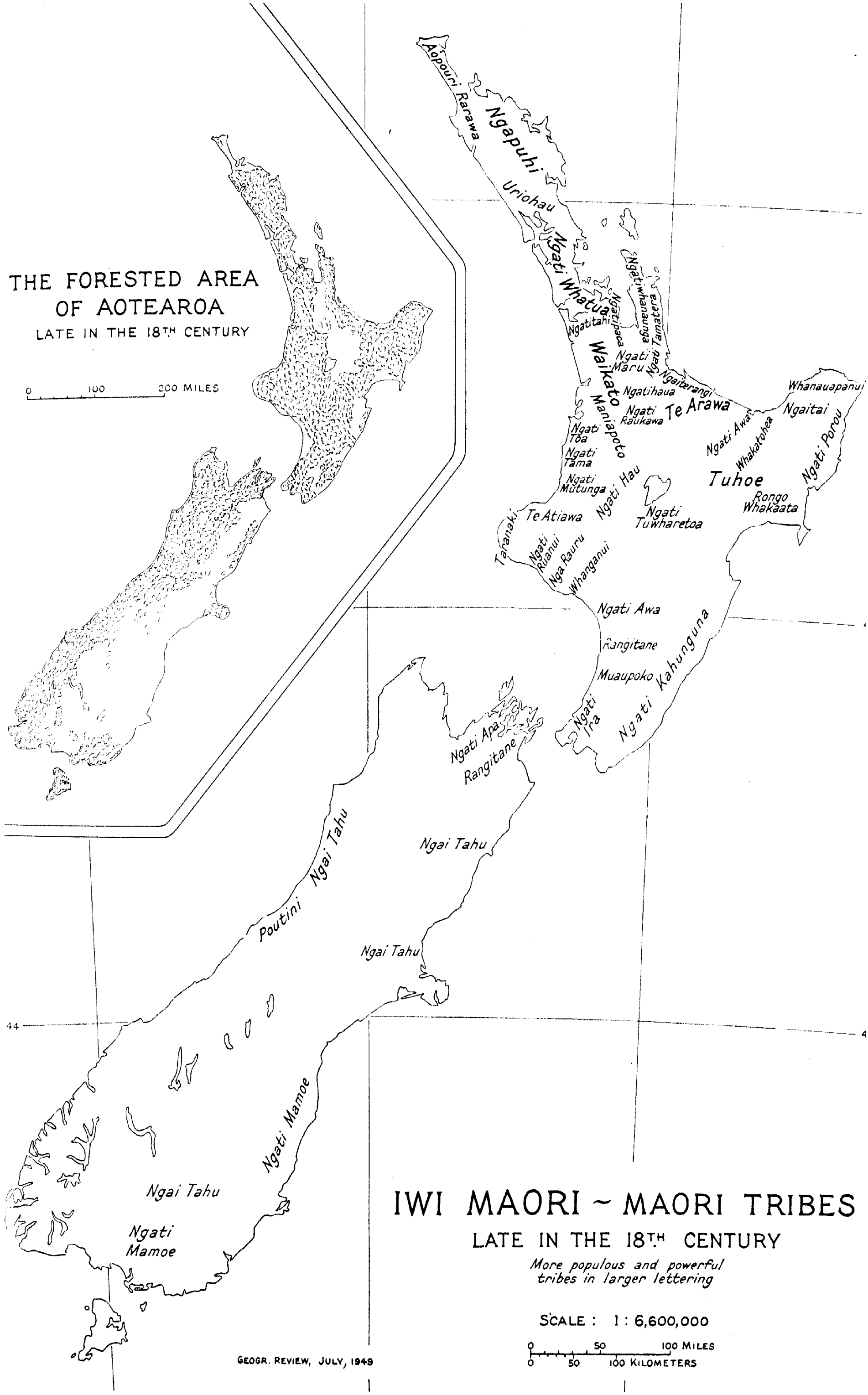
Forest and shrubland, widespread in Te Ika a Maui (Fig. 1, inset) provided many raw materials: kauri, kahikatea, and *totara,* of huge girth and great height, for major constructional use and for making his canoes; smaller timbers in a wide range of hardness and durability for housing, tools, weapons, and agricultural implements; bark for roofing and many-colored dyes; ferns and aerial roots for eelpots; lianas for lashings. In the swamps, on the riverbanks, and on the outer margin of the bush were *raupo* for thatching and for walls, *toetoe* for interior linings, and *harakeke* (*Phormium tenax*), with a thousand uses but principally for clothing, cordage, binding, lashing, and fishing nets.

Uncultivated plants in the bush provided berries and nuts; the tree fern, the *nikau* palm, and indigenous species of ti furnished vegetable titbits to vary the diet. But the ubiquitous *Pteridium* of heath and shrubland was long the most widespread forest staple and the principal stand-by of all tribes except a few in the north with a wider range of domestic food plants and more extensive cultivations. It was the thick, edible rhizome of the *aruhe,* or bracken fern, which the Maori grubbed, and which saved many a tribe when its winter store of birds, dried fish, or kumara had been denied it after a death-dealing raid by some neighboring war party.

The forest also provided flesh food. The profusion of bird life in Aotearoa was commented on by all early explorers, and for centuries the Maori had been an expert fowler. The forest-dwelling tribes of the interior of Te Ika a Maui made birds a staple food and bird snaring a major economic activity, organized on a community basis and hemmed round by magico-religious ceremony and tapu, all of which served to make the best possible use of available resources without depleting them. The Maori rat also was trapped for food, chiefly among forest tribes.

On the littoral and about the lakes and swamps fish, both fresh and dried, was the principal article in food economy. Sea fishing and its succession of different tasks (from making giant seines from harakeke to preserving fish for the closed season) regulated the annual rhythm among coastal communities, as agriculture did among other tribes. Taupo and Rotorua tribes devoted much time to fresh-water fishing; tribes living on the Waikato, on the Whanganui, and adjacent to the streams and rivers of the east coast of Te Waka a Maui and Murihuku depended largely on their skill in digging canals, constructing eel weirs, making eelpots, and catching, preparing, and preserving *tuna* (eels).

Fig. 1 (opposite)—Distribution of Maori tribes and (inset) forests in the late eighteenth century. The tribes frequently gave their names to the districts they inhabited.



THE FORESTED AREA
OF AOTEAROA
LATE IN THE 18TH CENTURY
0 100 200 MILES
Aopouri
Rarawa
Ngapuhi
Uriohau
Ngati Whatua
Ngatiwhanaunga
Ngati Tamatera
Ngatipaoa
Ngatitahi
Waikato
Ngati Maru
Ngaiterangi
Ngatihaua
Ngati Raukawa
Te Arawa
Maniapoto
Ngati Toa
Ngati Tama
Ngati Mutunga
Ngati Hau
Ngati Awa
Whakatohea
Whanauapanui
Ngaitai
Ngati Porou
Tuhoe
Rongo Whakaata
Ngati Tuwharetoa
Te Atiawa
Taranaki
Ngati Ruanui
Nga Rauru
Whanganui
Ngati Awa
Rangitane
Muaupoko
Ngati Kahunguna
Ngati Ira
Ngati Apa
Rangitane
Ngai Tahu
Poutini Ngai Tahu
Ngai Tahu
Ngai Tahu
Ngati Mamoe
Ngai Tahu
Ngati Mamoe
44
4
IWI MAORI ~ MAORI TRIBES
LATE IN THE 18TH CENTURY
More populous and powerful tribes in larger lettering
SCALE : 1 : 6,600,000
0 50 100 MILES
0 50 100 KILOMETERS
GEOGR. REVIEW, JULY, 1949

Of the mineral resources of the islands, basalt and graywacke were employed to make adz blades, pounders, and sinkers, and obsidian flakes to fashion keen-edged implements. Sandstone was used for grinding, quartzite for making drill points, and various earths for coloring alike woodwork and the bodies of warriors. Most prized of the minerals was nephrite, *pounamu,* milky green to transparent emerald, a stone that, because of its restricted distribution, gave its name to parts of Te Waka a Maui (Te Wahi Pounamu). From pounamu Maori craftsmen fashioned superior adzes and chisels and beautiful neck and ear ornaments.

Trade and Exchange

A system of gift exchange[11] was a response to specialization of production, itself an expression both of differential distribution of natural resources and of cultural practice and tradition. Food was the outstanding gift, but at times raw materials, weapons, and other products of specialized craftsmanship were exchanged. In Te Ika a Maui the trade was principally between littoral and interior: fish products, shellfish, and agricultural foodstuffs constituted the gifts of coastal tribes; in return they received calabashes of preserved birds, bird skins, feathers for ornament, and ocherous earths. It would seem that the scattered peoples of Te Waka a Maui, less well endowed by Nature, carried on a larger per capita exchange than the peoples of Te Ika a Maui. They had greater wants and at the same time had control of, or access to, the only supplies of pounamu. Pounamu was found only in the valley of the Arahura on the Poutini Coast, but in Fiordland, in the extreme southwest, there was a source of *tangiwai* (bowenite), more beautiful for ornaments but less durable and hard for weapons.[12] Both were exchanged either as raw material or as beautifully fashioned *mere,* ear pendants, *tiki,* and cutting tools. Much of the trade was between the islands, and in return the southern tribes obtained taro, kumara, and hue calabashes. In Te Waka a Maui much of the trade in pounamu was across the mountains. Kaiapohia seems to have been an important trading point. Pounamu came there by way of certain passes in the Southern Alps in exchange for textiles, mats, and scents, and from Kaiapohia the greenstone was redistributed both north and south. By virtue of its exchange function Kaiapohia was a center of overland routes.

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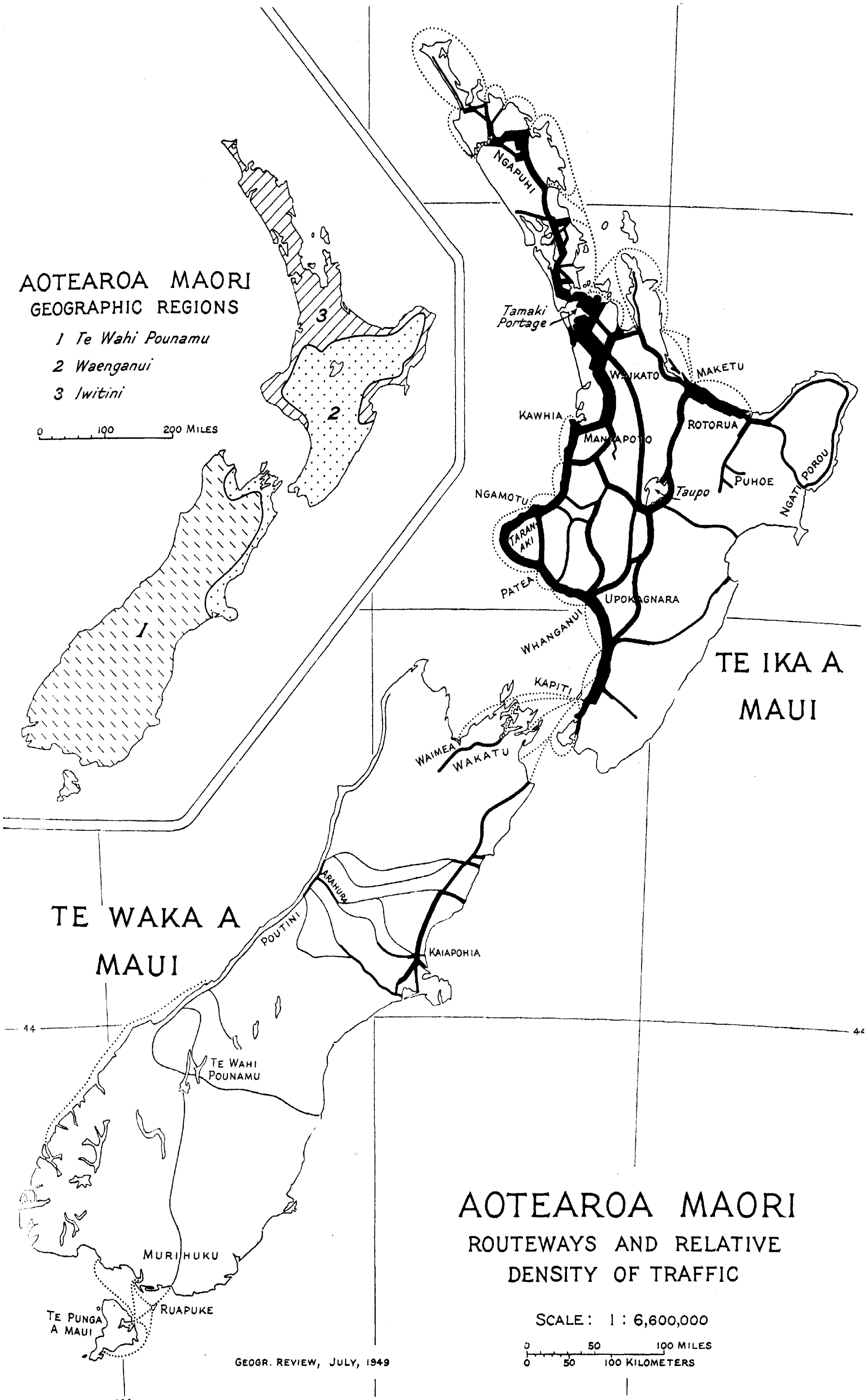
[11] Firth, *op. cit.,* Chap. 12.

[12] H. D. Skinner: Maori Life on the Poutini Coast, Together with Some Traditions of the Natives, *Journ. Polynesian Soc.,* Vol. 21, 1912, pp. 141–151. "Poutini is the name given to that branch of Ngai-Tahu that lives on the West Coast of the South Island of New Zealand, and from the people comes the name of the coast" (p. 141, footnote*).

FIG. 2 (opposite)—Routeways, showing traffic density, and (inset) main geographic divisions. Routes on land include both canoe-river ways and tracks through forest and over tussock grasslands.


AOTEAROA MAORI
GEOGRAPHIC REGIONS
1 Te Wahi Pounamu
2 Waenganui
3 Iwitini
0 100 200 MILES
NGAPUHI
Tamaki Portage
WAIKATO
MAKETU
KAWHIA
MANIAPOTO
ROTORUA
PUHOE
NGATI POROU
NGAMOTU
Taupo
TARANAKI
PATEA
UPOKONGARA
WHANGANUI
KAPITI
TE IKA A MAUI
WAIMEA
WAKATU
ARAHURA
POUTINI
KAIAPOHIA
TE WAKA A MAUI
TE WAHI POUNAMU
MURIHUKU
RUAPUKE
TE PUNGA A MAUI
44
AOTEAROA MAORI
ROUTEWAYS AND RELATIVE
DENSITY OF TRAFFIC
SCALE: 1 : 6,600,000
0 50 100 MILES
0 50 100 KILOMETERS
GEOGR. REVIEW, JULY, 1949

Under certain circumstances the services of specialist craftsmen were exchanged. Practically all Maori tribes were largely self-sufficient; each had its own specialists in the manufacture of tools and weapons, the preservation of foodstuffs, the fabrication of clothing, fishing nets, bird snares, and the like. Wood carvers, tattooers, medicine men, and dispensers of black magic —tohunga or experts—were found in all tribes, but the reputation of some spread beyond the bounds of their own tribe, and their services were in demand in distant areas; and for these, garments, food, and ornaments were tendered in exchange.

Transport and Communications

The neolithic Maori was no stay-at-home. His great interest in his surroundings, his geographic curiosity, his social obligation to attend feasts and mourning assemblies, his warring raids and expeditions, and his peaceful trade and exchange took him frequently into the territories of other tribes. That pounamu was found among the northernmost tribes and that obsidian from Tuhua (Mayor Island), in the territory of the Ngai Te Rangi, was in use in Te Punga a Maui (Stewart Island) are indications of intercommunication. People and goods moved by two means—by overland tracks and by canoe ways. Travel through the dense forests of Te Ika a Maui and over the tussock plains and rocky alpine passes of Te Waka a Maui was single file on narrow tracks in bare feet or sandals. Where suitable waterways existed, they were highways for canoes large and small. The network of communications in pre-European Aotearoa shown in Figure 2 reveals the importance of the sheltered sea routes for the tribes of the northern peninsulas and the significance of the Tamaki portage in linking east and west. It also demonstrates the importance of interior connections utilizing especially the larger rivers—the Waikato, the Waipa, the Mokau, the Mangawhero, the Rangitikei, and the Waipaoa. On the other hand, exposed coasts such as the west coast of the northern peninsula and the Poutini Coast of Te Waka a Maui had little coastwise communication. Between the Ngati Whatua north of Tamaki, the Ngati Tuwharetoa of Taupo, the Taranaki tribes of the west coast, and the smaller tribes nearer Raukawa (Cook Strait) there was a denser net of land communication than today; but the main through route was largely coastal, and exclusively so between Kawhia and Te Whanganui a Tara. In Te Waka a Maui main routes, though not so numerous, were again long and largely coastal. The relatively large-scale development of communications here is due not to the density of the population but rather to its more nomadic habits and the poverty of resources, especially agricul-

tural resources. The importance of the pounamu trade from the Poutini Coast is reflected in the number of its transalpine routeways, unequaled by the present-day exploitation of coal on that coast; the Maori regularly made use of nine passes, whereas European traffic uses but two.

Geography of Settlement

By both tradition and practice the Maori was gregarious, as in fact he still is. He lived in clustered and irregularly nucleated settlements. The hapu or subtribe was the usual unit of group settlement and numbered from a score or more to perhaps at times several thousand individuals. In the first century or two of Maori settlement of Aotearoa, when the earlier generations were battling with a new and strange environment, and when total population was still small, their labors must have been heavy indeed. Until he had perfected the new tools, skills, and techniques that enabled him to utilize the resources of his new home, the Maori lived in village communities near the most valuable resources of the different habitats—forest, river, swamp, fertile soil, and the sea. He called his settlement *kainga*, a term that signifies "home" or "residence." In those days defense requirements did not influence the siting of the villages.

But after two or three centuries of successful pioneering the tribes fortunate enough to have settled in the northern peninsula, on the rich volcanic coast of Taranaki, in the Hauraki, and on the littoral between Tauranga and Whakatane had gained sufficient mastery over their habitats to have time on their hands during the winter. Increasing leisure made it possible, through an extension of games such as canoeing, swimming, and wrestling, and through a redirection of the skills and fervor of the hunt, to develop the arts of intertribal war. Brief forays and sporadic raids became regular and annual warfare of a ferocity rarely equaled, and characterized by the massacre of the enemy warriors and the enslavement of their women and children. Cannibalism was an essential feature. In the regions most frequently affected, defense became as important as attack, and the hapu built their *pa*.[13]

Pa signifies "a fortified settlement." The word is derived from a verb meaning "to obstruct" or "to block up." Although the fortified village (Fig. 3) became the characteristic unit of settlement with the most powerful

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[13] Elsdon Best: The Maori, *Memoirs Polynesian Soc.*, Vol. 5, 2 vols., Wellington, 1924, especially Vol. 2, Chap. 15; *idem:* The Pa Maori, *New-Zealand Dominion Museum Bull. No. 6*, Wellington, 1927; R[aymond] W. Firth: The Korekore Pa, *Journ. Polynesian Soc.*, Vol. 34, 1925, pp. 1–18; *idem:* Maori Hill-Forts, *Antiquity*, Vol. 1, 1927, pp. 66–78; W. H. Skinner: The Ancient Fortified *Pa*, *Journ. Polynesian Soc.*, Vol. 20, 1911, pp. 71–77.

and numerous tribes of Te Ika a Maui, it was rarely found in the volcanic interior of the island or on the Manawatu and Horowhenua coasts, and it was practically unknown in Te Waka a Maui except for a few diminutive and badly constructed pa built when raids and warfare crossed Raukawa late in the eighteenth century. Much of the effort formerly devoted to ob-

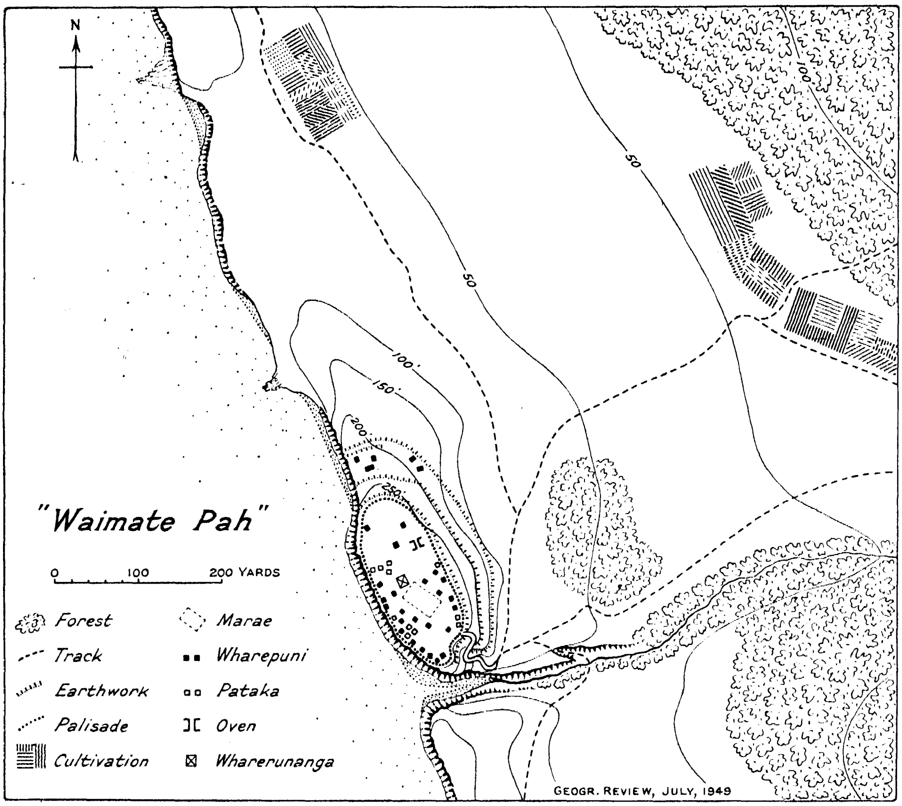

FIG. 3—Fortified Maori *pa* on the thickly populated coast of Taranaki (see Fig. 2).

taining a livelihood was now diverted to the construction of pa, with their skillfully engineered fortifications. The exigencies of defense frequently made it necessary to choose sites distant from the community cultivations and tribal forest or fishing grounds, so that rude "outvillages" or rough temporary shelters had also to be constructed, one handy to the tribe's oyster and *pipi* beds, another near its fowling grounds, and so on. But in the late 1700's most Maori communities in Aotearoa lived mainly in pa.

The largest and most elaborately defended villages were centered on the basaltic soils of the northern peninsula and amidst the extensive cultivations and at the crossroads of communications on the Tamaki isthmus. The strong-

holds were built on isolated hill sites (the smaller tuff, scoria, and lava cones proved ideal), on ridges, spurs, coastal headlands and peninsulas, cliffs, islands, river terraces, and steep riverbanks. They were fortified with elaborate timber stockades and, when the terrain permitted, with earthworks also. Abundant evidence remains in the form of tiered linchets, terraces, ditches, and high ramparts, though the timbered palisades have long since disappeared. Although it is doubtful whether all the pa in a locality were occupied simultaneously, to man many of them would have taken a Maori population far larger than that now living in the same region and even considerably larger than the first observers found in many of the pa or their vicinity. Here is further evidence of the decrease in population that followed the development and spread of large-scale intertribal warfare as a characteristic feature of Maori life and culture.

Whatever its defensive works or its configuration, the pa had a characteristic assemblage of buildings and range of functions, which repeated in detail the internal morphology of the old-time kainga (Fig. 3). If the summit of the defended site was large and relatively level, this was the core of the settlement. If, however, the summit was small, it would accommodate the *whare* of the tribal chiefs, and the center of activity would be on a wide terrace or other open stretch of ground at a lower elevation. The *marae,* the Maori equivalent of a village green or square, small and trodden bare by incessant use, was the heart of the settlement. Here both young and old spent most of their time. Around it were grouped irregularly the *wharepuni* that formed the sleeping quarters of loosely extended family groups or whanau. The wharepuni was a rectangular hut, 10 feet by 12 feet, with an excavated clay or earth floor; it was built of poles or carefully worked timbers and was lined with reeds and fronds of tree ferns. The sleeping quarters were cramped and crowded, ventilated only by a small sliding door and window opening onto a front gabled veranda, which provided shelter for daytime open-air living in weather unsuited to extensive communal activity. Occasionally the wharepuni were separated by low fences or other marks on the basis of genealogical grouping. Largest and most striking of the village structures, because of its size and massive ornamentation, was the whare runanga or *whare whakairo,* the meetinghouse or carved house, the Maori equivalent of a village hall. It was placed at the end of the marae opposite the main entry and dominated the village as it dominated the field of material culture. It represented the pinnacle of Maori artistic creation and was the supreme result of communal efforts and toil. It was the cooperative product of the labor of the unskilled workers who hauled and set up

the mighty timbers and of the experts who selected the trees, appeased Tane, thatched the roof, paneled the interior, decorated the walls, carved jambs and lintel shields, and ornamented the massive, deep bargeboards and supporting posts. At the same end of the marae were the dwellings of the tribal elders and tohunga, more elaborately constructed and decorated than the wharepuni. In addition, the pa was adequately provided with *pataka* or storehouses, some of which were profusely carved structures elevated on one or more posts, others simple raised platforms or racks, and still others semisubterranean or wholly subterranean pits. Here the Maori kept many prized possessions: calabashes of water, dried fish, fern root, kumara, preserved birds, nets, fishing gear, cordage, paddles, garden tools, and spare weapons. Elsewhere within the inner palisade and rampart were the communal cooking sheds, simple structures, sometimes without roofs, and with walls of stacked firewood, which enclosed the stone cooking ovens and steaming pits.

Size of Population

Cook estimated the population of Aotearoa in 1769–1774 at 100,000. There is universal agreement, however, that this otherwise reliable observer seriously underestimated the numbers of the Maori. He did not penetrate inland and had only an imperfect acquaintance with the littoral; he had no firsthand knowledge of many of the most populous districts—Taranaki, the Waikato, the Tamaki isthmus, Rotorua, Taupo, Kaipara, and Hokianga. After seven decades of warfare unequaled before in extent, slaughter, violence, and efficiency, after half a century of intertribal use of European weapons, and after the ravages of introduced diseases on a population already decimated by war, Dieffenbach, a reliable reporter, estimated in detail the population of the different tribes and districts and placed its total at 114,890.[14] If Walsh's estimate[15] that the campaigns of Te Hongi, Te Wherowhero, Te Waharoa, and Te Rauparaha reduced the Maori population of Aotearoa by half, then at the turn of the century and before these disastrous wars developed, the population must have been 300,000. Te Rangi Hiroa suggests that at the time of Cook's voyages the Maori might have numbered 200,000 to 500,000; they were "at least" four times as many as "the men of the present" (some 50,000 at the census of 1921), and ten times as many "does

[14] Dieffenbach, *op. cit.*, Vol. 1, p. 195, provides a table showing in detail "the Names of the Native Tribes on both sides of Cook's Straits, with an approximation to the Number of Souls in each"; in Vol. 2, p. 83, is a "Table of the Tribes and Population of New Zealand."

[15] Archdeacon Walsh: The Passing of the Maori, *Trans. and Proc. New Zealand Inst.*, Vol. 40, 1907, Wellington, 1908, pp. 154–175; reference on p. 158.

not seem improbable."[16] In view of the reserves of bird life, fish, forest fruit, and timber and of cultivable soil, and in view of the equipment at the disposal of the people, their skills, and their knowledge, Aotearoa could without doubt have supported a million people with the Maori's neolithic culture. And there is sufficient evidence to prompt the suggestion that the islands might well, at times, have sustained a population considerably larger than half this number during the eighteenth century.

This evidence is to be found in many a landscape in all parts of the country, but especially in northern parts of Te Ika a Maui.[17] Along the Taranaki coast line the fortified villages of a once dense population hang closely like beads on a string. Within what is now the Auckland metropolitan district is a series of volcanic cones most of which bear the deep impress of human occupance and were "tattooed like the faces of... warriors . . . spared from the carnage of the cannibal age" by 12-foot-high terraces and earthworks, the remains of forts of the Ngati Whatua that housed and sheltered, according to the estimate of Hochstetter, from 20,000 to 30,000 people.[18] In the Oruru Valley in the far north, west of the Bay of Islands at Taiamai, in the Waimana and Whakatane Valleys, *pa maori* were once as numerous as are *pakeha* farms of a later age. Many of them are variously estimated to have required 3000 men and more to defend them and many more to build them.[19]

Early European intruders found much evidence of cultivations that had still been in production a generation or so before their arrival; and Best, the foremost authority on Maori life and culture, repeatedly refers to cropping grounds, more extensive than was formerly realized. And considering the aggressiveness of the indigenous vegetation of New Zealand, it may be that other areas once under careful cultivation had been hidden, disguised, and lost before the advent of the pakeha. Farmers, builders, horticulturists, and engineers are constantly unearthing new evidence of the extent of early Maori settlement and activity in the form of shell middens, field systems, defensive works, and *rua*, or storage pits, especially in the north where settlement is known to have been frequent if not as dense as is now becoming appreciated.

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[16] Te Rangi Hiroa (Sir Peter H. Buck): The Passing of the Maori, *Trans. and Proc. New Zealand Inst.*, Vol. 55, 1924, pp. 362–375; reference on p. 364.

[17] F. E. Maning: Old New Zealand, London, 1863, especially Chap. 13; S. P. Smith: History and Traditions of the Taranaki Coast, New Plymouth, 1910.

[18] Ferdinand von Hochstetter: New Zealand: Its Physical Geography, Geology and Natural History, translated from the German original published in 1863 by Edward Sauter, with additions up to 1866 by the author, Stuttgart, 1867, p. 243.

[19] Best, The Pa Maori (*op. cit.*), especially pp. 211–222.

Distribution of Population

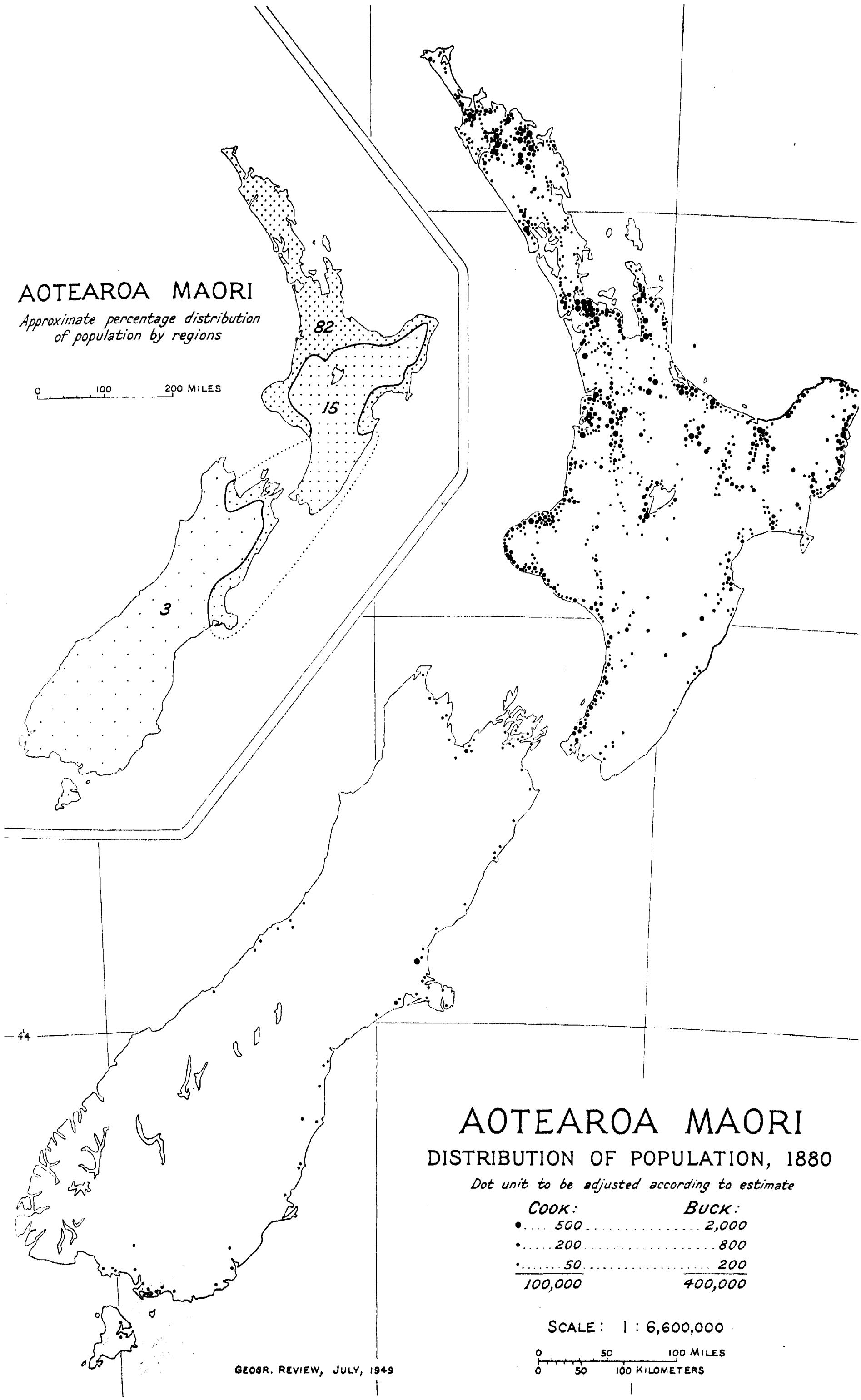
But whatever the maximum numbers attained by the Maori people, there is much less doubt about their relative distribution. There is evidence enough in the early accounts of New Zealand and on the earliest maps of the islands (as distinct from charts of the coast line) to enable one to construct a map showing the distribution of the Maori population in the first or second decade of the nineteenth century; and there is sufficient record of the movement and migration of the warring and the defeated tribes in the generation before that to permit a generalized mapping of the relative spread of the indigenous population before its disruption by European culture. The pattern is apparent even if the numbers of the people are open to argument. The accompanying map (Fig. 4) is based largely on Dieffenbach's description of the distribution of the Maori in 1840 and the accounts by him and others of the changes brought about indirectly by alien interference in the decades immediately before. The numbers represented by the different sizes of dots must be adjusted according to the preferred estimate of the Maori population a generation after Cook's visit.

It is convenient to summarize and highlight the geography of Aotearoa Maori toward the close of the eighteenth century by dividing the country into geographic regions and pointing to their contrasting characteristics. Skinner[20] has already delimited "culture areas" for pre-European Aotearoa in terms of "all objects which fall within the scope of a museum collection." Although his regional approach and incomplete description of the material culture of these areas are stimulating and suggestive to the geographer, the areas themselves are not strictly appropriate to the latter's purposes, particularly since they ignore many factors on which his interests are centered, and since, as a result, the boundaries have a general appearance of artificiality and geometric regularity. For the present purposes it is sufficient to recognize simply three geographic regions (Fig. 4): Iwitini (Northern), Waenganui (Central), and Te Wahi Pounamu (Southern).[21] In virtually all phases of their geography, both physical and cultural, the northern and southern regions of Aotearoa Maori stood in sharp contrast with each other, and between them the central region was in many ways transitional yet not

[20] H. D. Skinner: Culture Areas in New Zealand, *Journ. Polynesian Soc.*, Vol. 30, 1921, pp. 71–78.

[21] The Maori names for these regions have been coined for the present purpose, since the Maori themselves had none. They often referred to parts of the interior of the South Island as *Te Wahi Pounamu*, "the place of greenstone," and a corrupted version of this, *Te Wai Pounamu*, "greenstone water," was early applied by Europeans to the whole of the South Island. The other two names were chosen to refer to a general characteristic of the particular region. *Iwitini* signifies "many people" or "a host of tribes"; *Waenganui*, "central," "in between," or "transitional."

Fig. 4 (opposite)—Population distribution and (inset) relative density by geographical regions.



AOTEAROA MAORI
Approximate percentage distribution of population by regions
0 100 200 MILES
82
15
3
44
AOTEAROA MAORI
DISTRIBUTION OF POPULATION, 1880
Dot unit to be adjusted according to estimate
COOK: BUCK:
500 ... 2,000
200 ... 800
50 ... 200
100,000 400,000
SCALE: 1 : 6,600,000
0 50 100 MILES
0 50 100 KILOMETERS
GEOGR. REVIEW, JULY, 1949

without its own distinctive characteristics. Two related features, the general habitability and dependent density of population and the spread of multiple-crop and single-crop agriculture, define and contrast the regions.

Te Wahi Pounamu, The Southern Region

The southernmost of the three geographic regions of Aotearoa Maori had by far the largest area and the smallest population. It comprised all of Te Waka a Maui except the northeastern littoral. It was more extensive than the central and northern regions together but contained not more than 3 per cent of the total population of Aotearoa (Fig. 4). Its frosty and unsheltered grasslands, its unsocial *Nothofagus* forest, and its snowy alpine interior refused the Maori attractive habitats. Only on the east coast from Te Punga a Maui (Stewart Island) to Waihora (Lake Ellesmere) and on the Poutini Coast north of the fiords did a sparse population find conditions that encouraged permanent settlement and sites suitable for the construction of tiny villages.

The culture of the small seminomadic tribes was simpler than that of the tribes living farther north and was indeed not markedly different from the Moriori culture of the Chatham Islands. The southern Maori had no cultivated crops, not even the kumara, but they were able to wrest a living from hostile environments by hunting, fishing, and gathering. Their difficulties and efforts were increased after the extermination of the *moa*. But although they could not grow kumara, taro, or hue, they could obtain these foodstuffs from localities more favored by climate in exchange for such products of the fowler's skill as abounded in Murihuku's swamplands and on its lake and sea shores—muttonbirds, ducks, quail, *weka*, pigeons, and swamp hens. Eels were abundant, and fresh-water crayfish available. The sea yielded fish, shellfish, seals, and edible seaweeds. The staple food, however, was aruhe; the prolific fern root was nearly always at hand, if not as succulent or quite as ubiquitous as in Te Ika a Maui.

The struggle for existence left little time for the building of elaborate permanent kainga and even less for the arts of either peace or war. Settlements were merely loose hamlets without order or form, crude, small, and widely separated, with no defensive earthworks. Huts were low, untidy, and coarsely thatched, built on the ground and not on piles; often a circular hut not found in the other regions was the only form. Wood carving was almost entirely lacking on houses and canoes alike; occasionally, simple rectilinear patterns were employed, and here and there were primitive paintings on limestone outcrops and the walls of shallow caves.

The southern Maori, inferior in culture and in material equipment, was possibly of smaller stature also. His dialect was distinctive. The tribes were isolated, scattered, few, and timid. Skinner recognizes the people and their culture as "distinctively Polynesian" and is tempted to suggest that they were a remnant of a late immigrant wave from eastern Polynesia that, finding the more desirable, warmer habitats of Te Ika a Maui already settled and relatively densely peopled, moved on to the less attractive regions of Te Waka a Maui.

WAENGANUI, THE CENTRAL REGION

The central region of Aotearoa Maori showed considerable diversity of physical habitat. The bleak, exposed, grassy plateau of the interior of Te Ika a Maui, with its light but inhospitable soils of volcanic ash, the swampy and forested littoral exposed to the west, the warm, dry, and sheltered bay-head plains at the northern extremity of Te Waka a Maui were among the varied landscapes on which are superimposed sporadically and unevenly the traces of Maori occupance. An area almost twice that of the region to the north was occupied by only 15 per cent of the total population.

Relatively low density of a patchily spread population, the possibility of cultivation, the small importance of agriculture, the significance of the network of routeways, the importance of the districts fronting on Raukawa in the Maori pattern of trade and communications, and the transitional character of the region in so many features of Maori material culture—these were the distinctive marks of the central region.

Possibly only the Tuhoe people in the remote, bush-clad Urewera did not regularly practice agriculture. The Ngati Tuwharetoa of Taupo also relied heavily on birds, berries, and fish from the lake. Here and in the Urewera berries of the *tawa* and *hinau* were stored for winter use; birds, rats, and fern root were preserved; and even earthworms, grubs, and the *tuatara* lizard were utilized for food. But, in general, soils and climates permitted the Maori to practice his particular intensive form of agriculture, if only to a small extent, though uncultivated foodstuffs, garnered from forest, river, lake, swamp, or open heathland, provided the greater part of the food supply. The small fields of the hapu were rarely devoted to anything but kumara. Probably only in the lower Waimea Valley were any other crops cultivated, and even here the kumara was not raised without difficulty, as is shown by the labor and time expended on the artificial improvement of the soil. Kumara was grown in significant quantities southward along the eastern littoral of Te Waka a Maui to the vicinity of Waihora.

Despite its frosts and relatively short growing season, Kaiapohia was a center of production, again with painstaking care.

Since Waenganui bestrode Raukawa and lay between densely peopled north and sparsely occupied south, it early became a crossroads and, at its southern end, a focus of routeways. Its importance grew as a result of the increasing belligerency of the northern tribes and the greater mobility that accompanied and followed any interval of intertribal warfare. The coastal route from Kawhia to Te Whanganui a Tara, the inland routes from the Waikato and the Waipa by forest track and river to the Wanganui, the Mangawhero, and the Rangitikei and out to the Manawatu coast, and the route from the open and cultivated lands of Heretaunga and Ruataniwha via the Manawatu gorge were all followed by war parties or by refugee tribal remnants moving southward. From the Manawatu littoral they usually took to canoes to explore the relatively unoccupied northern parts of Te Waka a Maui. In general, Waenganui increased its population during the later decades of the eighteenth century and the early part of the nineteenth at the expense of emigration from Iwitini. Kaiapohia,[22] jumping-off place into the relatively little-known Te Wahi Pounamu and center for the trade in greenstone from Arahura; Kapiti, southern terminal of land routes in Te Ika a Maui; and Kawhia, where the main north-south route struck inland toward the navigable Waikato, appear to have been important cosmopolitan centers and important nodal points.

In details of material culture Waenganui was transitional. What Skinner has termed the "Northern" and "Southern" cultures were often blended here, especially about Raukawa. Villages were larger than in the south; they were sometimes built away from the coast and were sometimes provided with crude defense works. As in the far south, double canoes were frequently used, and outriggers occasionally. Houses, like canoes, were not elaborately carved or decorated, but the circular hut was replaced by a more permanent and substantial rectangular dwelling.

Iwitini, The Northern Region

Small and largely coastal, Iwitini was differentiated from areas to the south or inland by its almost continuous settlement and its persistently high density of population. It probably contained more than 80 per cent of the Maori people of the time and showed a concentration of population relatively larger than that of any later period, except the urban concentrations of modern times. The attraction of the region lay largely in its climate and

[22] J. W. Stack: Kaiapohia, Christchurch and Dunedin, 1906.

its general suitability for cultivation of several of the subtropical food crops that the Maori had brought with him from the islands of Te Moana nui a Kiwa to the north and northeast. The "winterless North," the somewhat broader southern (Waikato-Hauraki) part of the peninsula, and the narrow littorals skirting the upland interior of the island to both east and west all have a relatively low incidence of ground frosts, ample precipitation, and abundant sunshine. Not only kumara, but also taro and hue and occasionally yams, were cultivated, with considerable skill and with tapu-regulated precision. The frequency with which storage pits still riddle many a hillside in what was Iwitini testifies not only to the former extent of Maori cultivations but also to the success of their cropping and the size of the kumara harvest.

Yet the north was not exclusively concerned with an intensive form of agriculture; fishing, fowling, and collecting were practiced. But the forest too, in its greater variety and density, and the rivers, lakes, and coastal waters were kindlier than in the south. Although life here was still unremitting toil, except in winter, when sport and warfare demanded energy of a different kind, it was, by comparison with that of the people of Murihuku, for example, a life of relative ease.

It was in the large settlements of the powerful tribes of the north—Nga Puhi, Ngati Whatua, Ngati Tahi, Waikato, Maniapoto, Ngati Awa, Te Arawa, and Ngati Porou—that the culture of the Maori was most highly developed. The larger settlements were small towns, which not infrequently accommodated more than 3000 people. In the more populous areas—the Taranaki coast, the warm lakes district of Rotorua, the littoral between Whakatane and Maketu, the Tamaki isthmus, and the tribal domain of the mighty Nga Puhi—nucleated settlements of several hundred to 2000 people occupied almost every hilltop, spur, or coastal projection, and around and between them were the cultivated fields of the hapu. Almost without exception in 1780 such settlements were heavily fortified pa. Trench, rampart, or stockaded linchets were an essential feature of the "urban" landscape.

The pa consisted of large rectangular houses grouped about the massive and ornate whare runanga. Woodwork was invariably decorated with detailed carving. Perfect examples of such carving were bestowed especially on the meetinghouse, the elevated pataka, and the long single canoes. In detail, material culture varied from tribe to tribe. Not only did the people of Taranaki have a distinctive dialect, but their wood carving had a strongly marked local character; although their decorative art was curvilinear (in contrast with the rectilinear patterns of Te Wahi Pounamu) and full of life and vigor, it had not attained the more formal, mature design of the north-

ern spiral or the profusion and variety of the art of the Te Arawa at Rotorua.

The tribes of Iwitini were in constant and close contact with one another; such contact was almost as frequently warlike as peaceful. The region was threaded by a network of local tracks and routeways, and main highways followed the northern peninsula, the Waikato Valley, and the coasts to the east and west. The local diversity of environment made for frequent exchange of many commodities, and local specialization of craftsmen gave rise to an exchange of high-grade services. The broken east coast, especially from Maunganui to Whakatane, was the scene of regular canoe traffic. The Tamaki isthmus was probably the most frequented part of Aotearoa, and the meeting place of the most often traveled routeways on both land and sea. The portage from the Waitemata to the Manukau and thus to the Waikato was even more frequently used than the track by land from north to south along the length of the isthmus. This narrow neck of land, with its thickly concentrated large settlements and its continual coming and going of peoples from other areas was (until depopulated by prolonged and bitter warfare), as it is again today, the busiest hub of activity in the country. With its volcanic cones, its varied soils, its surrounding indigenous plant cover, its tidy cultivations, its local population of possibly 30,000 and its persistent stream of traffic from outside, its shell heaps, fishing grounds, and canoe landings, its forts and watchtowers, its clustered dwelling places and dominating meetinghouses, the Tamaki isthmus was in many ways an epitome of the geography of Aotearoa Maori. In the same way the vastly different stone and concrete agglomeration of wharves and houses, offices and factories, that makes up modern Auckland is largely representative of the same land but of that different people and urban culture which in 1949 together constitute the Dominion of New Zealand.

"HIGH" AND "LOW" ISLANDS IN THE EASTERN CAROLINES

RAYMOND E. MURPHY

"HIGH" islands and "low" islands present the classic contrast of the South Seas. Although islands of moderate height have been formed in the tropical Pacific in several different ways, the contrast is likely to be best developed where mountainous masses of volcanic origin jut from the ocean to form the high islands. Atolls, their *motus* or individual islets barely rising above the waves, form the low islands. Associated with this difference in geomorphology are many other differences, both physical and human, an appreciation of which is fundamental to an understanding of the geography of the tropical Pacific.[1]

Robert Louis Stevenson stated the case when he wrote:

> No distinction is so continually dwelt upon in South Sea talk as that between the "low" and the "high" island, and there is none more broadly marked in nature. . . . On the one hand, and chiefly in groups of from eight to a dozen, volcanic islands rise above the sea; . . . their tops are often obscured in cloud, they are all clothed with various forests, all abound in food, and are all remarkable for picturesque and solemn scenery. On the other hand, we have the atoll; . . . rudely annular in shape; enclosing a lagoon; rarely extending beyond a quarter of a mile at its chief width; often rising at its highest point to less than the stature of a man—man himself, the rat and the land crab, its chief inhabitants; not more variously supplied with plants; and offering to the eye, even when perfect, only a ring of glittering beach and verdant foliage, enclosing and enclosed by the blue sea.[2]

The paper here presented is a study of the contrasts as they were observed by the writer in the eastern Caroline Islands of the United States Trust Territory of the Pacific Islands. Field work was done in four distinct island groups. Ponape and Kusaie are high islands or island clusters; Mokil and Pingelap are atolls. As distances go in the Pacific, the four island groups are neighbors. Ponape, the westernmost, lies a little more than 300 miles west-northwest of Kusaie, the easternmost, and the north-south range of the four groups is only 120 miles. Substantial climatic differences rooted in latitude were therefore not in question, and fortunately there is a rough ethno-

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[1] For a recent popular presentation of the contrast between high and low islands in Micronesia see Walter Karig: The Fortunate Islands: A Pacific Interlude, New York and Toronto, 1948, pp. 40–45. See also E. G. Burrows: Topography and Culture on Two Polynesian Islands, *Geogr. Rev.*, Vol. 28, 1938, pp. 214–223.

[2] Robert Louis Stevenson: In the South Seas, New York, 1896, p. 152.

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TABLE I—COMPARATIVE DATA FOR FOUR ISLAND UNITS

ISLANDS	MAXIMUM ELEVATION *In feet*	LAND AREA *In sq. mi.*	POPULATION Jan. 1, 1948	*Per sq. mi.*	COPRA PRODUCTION *In tons per year*	*sq. mi.*	*capita*
High							
Ponape*	2579	129.0	5735	44.5	2800	22.0	0.49
Kusaie	2079	42.3	1652	39.0	600	14.2	0.36
Low							
Pingelap	<20	0.7	685	978.0	100	143.0	0.15
Mokil	<20	0.5	449	898.0	80	160.0	0.18

*Not including Ant and Pakin.

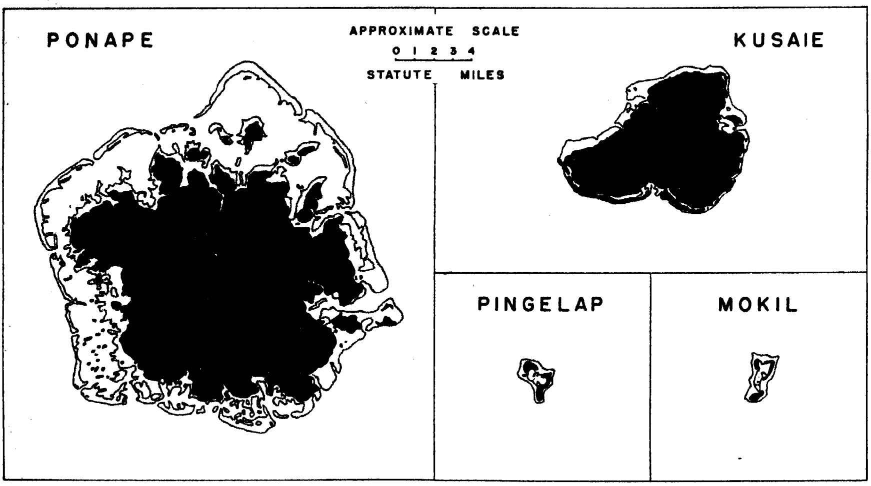

FIG. 1—Plan views of the four island groups on the same scale bring out striking contrasts (compare Table I).

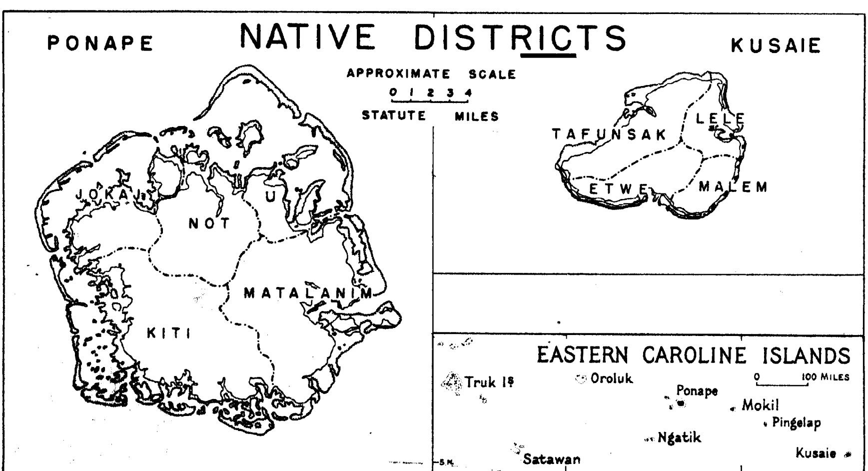

FIG. 2—Each of the two high islands has been divided traditionally into several districts. They are independent of one another in Ponape, but in Kusaie they acknowledge a single king.

FIGS. 3–5—Northern Ponape. Figure 3 (top), taken early in World War II, shows the village of Colony (Ponape) which was nost entirely destroyed by bombing. Figure 4 (left) shows a gently rolling area in northwestern Ponape; it had been in use under Japanese but was waste land in 1947. Figure 5 (right) is the agricultural experiment station at the former village of Ponape. gs. 3 and 5 are official U. S. Navy photographs.)

graphic similarity. Attention, then, could be focused on the fundamental contrasts in the physical and human geography of the two types of islands.

Physical Contrasts

The high islands and the low present, in the first place, physical contrasts, contrasts that prevailed even in the distant past when the first canoeloads of people arrived.

The fundamental physical contrast is in landforms. The mountainous islands of Kusaie and Ponape rise in the interior to peaks higher than 2000 feet (Fig. 6 and Table I). In both, the bedrock consists chiefly of basaltic flows. There are small interior areas of relatively flat land, especially in Ponape, which have been interpreted as the remains of elevated marine terraces (Fig. 4).[3] Each island group has a peripheral coastal belt where land is level enough to be usable, and there are very small flood plains. But by far the greater part of the land is too steeply sloping for profitable use.

On the other hand, the islets that make up the atolls of Mokil and Pingelap are low and flat. The bedrock of coral limestone is covered with coral sand and loose fragments of coral. Since the elevation is nowhere greater than 20 feet, no land is unusable because of ruggedness.

The difference in soils is striking. Here the volcanic islands have the better of it. Their soils, though variable in quality and locally of little agricultural use because of basaltic rubble, are much more productive than anything the atolls have to offer. In fact, the atolls can hardly be said to have a real soil. Coral sand with a little organic matter forms the surface layers. Such material is extremely porous and, though suitable for a small variety of plants, will not support agriculture at all in the ordinary sense of the word.

Plan views bring out further contrasts reflecting origin (Fig. 1). The two high island groups have a compact, symmetrical shape. Each comprises one main island and several much smaller bordering fragments. Surrounding the main mass of each and separated from it by a lagoon is a barrier reef, broken by occasional channels. The lagoon is almost continuous and is used as a passageway for canoes and locally even for some small Diesel-powered motorboats or "pom-poms" that the natives inherited from the Japanese. Changes in sea level in geologically recent times drowned the mouths of the rivers, and the resulting estuaries, together with the channels through the reef maintained by the rivers, form good harbors.

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[3] Josiah Bridge: Mineral Resources of Micronesia (Economic Survey of Micronesia, Vol. 3, Part 1), United States Commercial Company, Honolulu, 1946 (mimeographed), p. 95.

The two atolls consist of several islets roughly enclosing a lagoon.[4] A continuous coral platform surrounds each atoll (Fig. 10). It is not a barrier reef, and there is no channel through it. Mokil and Pingelap can be reached only by canoes and whaleboats, and the whaleboats, except at high tide, must be dragged part way across the reef.[5]

In part inherent in the differing origins of the high and low islands is the difference in size. Ponape is nearly 200 times, and Kusaie about 60 times, as large as Pingelap, the larger of the two atolls (Table I). In general, volcanic islands are fairly large.[6] Atolls, by their very nature, tend to be small; the largest in American Micronesia has a land area of only six or seven square miles, and the average is nearer one.

Climatic contrasts are less striking than land contrasts; nevertheless, some of them are sufficiently observable to be well known to the natives. The two volcanic islands have a higher average humidity[7] and receive considerably more precipitation than their lower neighbors. Records have been kept only for the volcanic islands, and even these records are far from satisfactory, but it is estimated that the average of 200 to 250 inches of rain a year is about twice that of the atolls. Moreover, the volcanic islands, because of their higher humidity, greater cloudiness, and greater rainfall, do not reach as high temperatures as the atolls—one of the contrasts of which the natives are aware.

Typhoons, fortunately, have been rare in the eastern Carolines. The last one recorded was in 1905. When typhoons have occurred, the low islands, lacking any real obstruction to wind and wave, have suffered more than their high neighbors. One must agree with the Pacific explorer Bougainville, who, upon contemplating the inhabitants of his first atoll, wrote:[8] "I admire their courage if they live without uneasiness on these strips of sand which a

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[4] For a map of Mokil Atoll see Figure 1 in R. E. Murphy: Landownership on a Micronesian Atoll, *Geogr. Rev.*, Vol. 38, 1948, pp. 598–614.

[5] Not all atolls and volcanic islands of the tropical Pacific show this contrast. Some of the larger atolls of American Micronesia have sufficiently large and deep lagoons and deep enough passageways through the surrounding reef to permit effective use for harbors.

[6] Truk, which consists of a large number of small volcanic islands inside a reef, would seem to be an exception to this rule. But Truk may be regarded as intermediate between a volcanic island group and an atoll. Submergence has gone so far that only scattered remnants of volcanic peaks project above tide.

[7] The writer had ample opportunity to note the humidity contrast. During a several weeks' stay at the Military Government base in Ponape he had constantly to combat the dampness. Mold formed quickly on shoes and suitcases. Improvised "hot lockers," made by inserting an electric light into a bureau drawer, were a necessity. In Mokil, where the writer spent seven weeks, such measures were unnecessary, though of course they would have been impossible in any event, since no electricity was available.

[8] [Louis Antoine de Bougainville:] Voyage autour du monde, 2nd edit., 2 vols., Paris, 1772; reference in Vol. 2, p. 14.

FIG. 6—Kusaie looking northward from the south coast early in World War II. Note Port Lottin, one of the several harbors of the Kusaie coast; the barrier reef with its cover of coconut trees; and bordering it the mangrove-filled lagoon (dark belt). (Official U. S. Navy photograph.)

FIG. 7 (left)—*Cyrtosperma Chamissonis* (known as *mwäng* by the natives), the chief food crop of Mokil and Pingelap.

FIG. 8 (right)—A pandanus tree in Mokil. Even in a single atoll there are likely to be a number of varieties of pandanus.

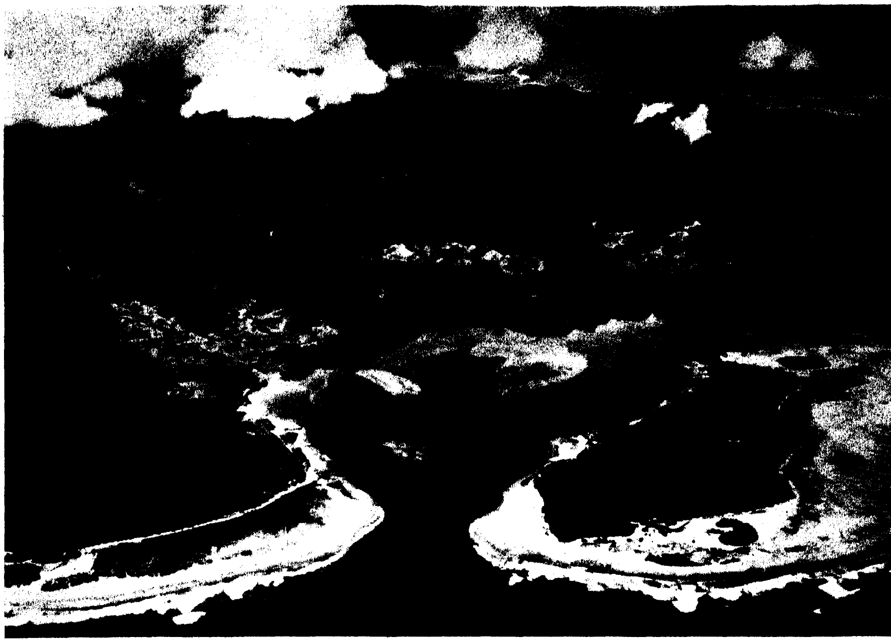

FIG. 9—Northeastern Kusaie looking westward across Lele Island and Harbor, early in World War II. The Japanese had brought in Okinawans and natives from Ocean Island, Nauru, and the Gilbert and Ellice Islands to grow vegetables for them. The land cleared for this purpose is now overgrown with weeds and brush. (Official U. S. Navy photograph.)

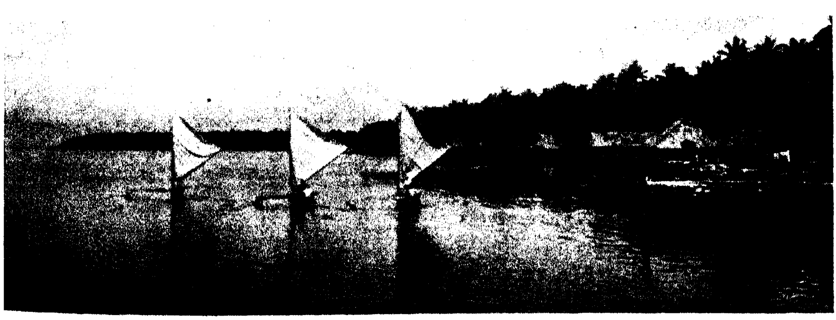

FIG. 10—Coral platform on the east side of Kalap, Mokil; at a lower tidal stage the entire reef platform is exposed.

FIG. 11—Native sailing canoes in Mokil lagoon.

tempest can bury under water in the winking of an eye." There is a legend of a typhoon that nearly wiped out the peoples of Mokil and Pingelap.

Fresh water is relatively abundant on the two high islands. The bedrock is porous, and a large lens of fresh water rests on salt water.[9] Surface streams are numerous and are used for bathing and for washing clothes as well as for drinking water. On the atolls water other than collected rainfall is available only in wells and is often brackish. The statement has been made that on some atolls of Micronesia the natives get along with as little as a gallon of fresh water per capita a day in contrast with double that amount for the high islands and the 20 gallons used at American bases on the islands.

Mineral resources are unimportant in the eastern Carolines, though on the volcanic islands there are deposits large enough to have awakened interest. Bauxite, a normal end product of weathering of some kinds of igneous rock in the wet tropics, and several minor metals have been noted. But although prospecting was carried on by the Japanese, especially in Ponape, there has been no commercial mining,[10] nor does it seem likely. No mineral deposits of any conceivable value have ever been found in either Mokil or Pingelap.[11]

Two other contrasts in the physical attributes of the two types of islands should be mentioned. The high islands have a much greater variety, luxuriance, and density of plant life than the atolls, where poverty of soil and brackishness of ground water are limiting factors. Native animal life is scarce in the eastern Caroline Islands, but again the superiority of the high islands is evident. Birds are much greater in variety and number than on the atolls, and birds, wild pigs, and even deer (introduced by the Germans) are sometimes hunted in Ponape and Kusaie.

Cultural Contrasts in the Past

The people of the two atolls have, in the first place, a background of greater intimacy with the sea than the high islanders. This is a contrast that extends far into the past. Nearly every family in Mokil, for example, has a record of ancestors coming from the Marshalls, from Pingelap, or from other atolls, but Ponape and Kusaie rarely appear in the records. For the last several generations at least, Ponapeans and Kusaieans seem to have found their own

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[9] This is much the same situation that prevails in Oahu in the Hawaiian Islands. There it has been much studied because the ground water is critical to the existence of Honolulu and Pearl Harbor.

[10] Bridge, *op. cit.*, p. 97.

[11] On some neighboring atolls—for example, Ngatik, which lies 80 miles southwest of Ponape, and Ebon, in the southern Marshalls—small deposits of phosphate occur. But the fairly large deposits that have given distinction to Nauru and certain other Pacific islands occur on what are, essentially, "raised" coral islands rather than on true atolls, such as those of the eastern Carolines.

islands sufficient. Low islanders have migrated to the high islands, but there has been little movement in the reverse direction.

The difference in extent of seafaring activities may well have an explanation somewhat like this: The dweller on a high island found greater food-producing possibilities, and had more room to travel and trade, within the limits of his own island group. When he did travel by boat, he could often avoid the open sea by using the lagoons that, for long stretches, run parallel to the shores of the high islands. The atoll man, whose resources were much scantier, had a greater incentive to take to the sea, both for fish and for other foods and supplies to be had through trading with the people of other island groups. Even within the atoll he had to be constantly traveling from island to island by canoe.[12]

Explorers, whalers, and missionaries all seem to have been more interested in the high islands than in the atolls. To the whalers the supply of fresh water available was a primary consideration. Ponape became a famous outfitting center, and so, too, did Kusaie. Only limited stops appear to have been made at the atolls, though the considerable element of white blood apparent at the present time indicates that they were not entirely neglected. Missions were established in the two high island groups, but Christianization of their small neighbors was the work of native missionaries trained in Ponape or Kusaie. The larger size of the high islands, their greater productivity, their superior harbors, and their greater numbers of native people made them more attractive to whalers and missionaries alike.

The same considerations ruled the later history of the eastern Carolines. Ponape was a base for the Spaniards. In 1887 they established the village of Colony (Colonia de Santiago) on the north coast, and this village continued as an important administrative center under the Germans and the Japanese (Fig. 3). Kusaie, though distinctly secondary to Ponape, was also of interest to the Germans, but ordinarily no German official was to be found in Mokil. The Japanese maintained a sizable, growing colony in Ponape and a smaller one in Kusaie,[13] but Mokil had only one permanent Japanese resident, and he combined the functions of schoolteacher, trader, and dentist.

[12] Dr. Josiah Bridge of the United States Geological Survey, who has worked in Micronesia and who read an earlier version of this article, suggested an additional basis for the contrast in seafaring activities between the two types of islands, at least during the Japanese period. He pointed out that the Japanese strongly discouraged native fishing outside the reefs and that they discouraged interisland travel as well. As there were virtually no Japanese residents on the atolls, the prohibition against outside fishing may have been largely ignored there, but on the high islands the Japanese attitude must have tended to discourage interest in the sea.

[13] In the late 1930's Japanese slightly outnumbered the natives in Ponape, but there were probably not more than 30 or 40 Japanese in Kusaie.

The rise of the copra industry emphasized the differences between the two types of islands. The two volcanic groups, being much larger, naturally had a much greater total copra yield. Moreover, since the high islands were not as crowded, it was possible to introduce plantation cultivation in addition to the ordinary native production.[14]

In the years before World War II certain nonagricultural activities had developed in Ponape and Kusaie, but particularly in Ponape, in which the natives had little part. Commercial fishing was in the hands of Japanese using Okinawan labor. There was some small-scale manufacturing in Ponape, including fish processing, papermaking, the making of starch from cassava and of alcohol from sugar cane, lumbering, soapmaking, ice making, cotton weaving, and cigarette making. Sawmills were operated in Kusaie, and a few minor industries developed.[15] On both the high islands electric power plants were in operation. But none of these activities was in native hands. The two atolls, with only native populations and without the resources for modern industry, had no part in such developments, but they did share in the rising handicraft trade.

In World War II the atolls of the eastern Carolines had an advantage. They were too small to be of interest to the Japanese, either for producing food or as defense bases.[16] They had, it is true, to furnish young men to work in Ponape, but the atolls themselves were never given serious attention. Both Ponape and Kusaie were fortified and were heavily bombed. The atolls, however, suffered chiefly from neglect. Their people, long accustomed to clothing and supplies from the outside world, had to rely entirely on themselves for the war period.

At the close of the war the high islands, particularly Ponape, faced new problems. The banishment of the Japanese had left much vacant land whose

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[14] Not all atolls are as densely peopled as Mokil and Pingelap, though such congestion seems to be usual. Some small atolls have no population and are put to no regular use. A few atolls were purchased or otherwise acquired by the ruling government or by some private concern at some time in the past and have been kept as copra plantations operated by the government or privately under some sort of concession. Ant and Pakin, two atolls a few miles west of Ponape, are of this general type. Ant is considered to be part of the Kiti District of Ponape; Pakin, a part of the Jokaj District of Ponape. Both have substantial coconut plantations that, in Japanese time, were operated from their respective Ponapean districts much as if the atolls were part of the Ponapean group. Indeed, they are sometimes grouped with Ponape under a single name, the Senyavin Islands.

[15] See the U. S. Navy Department's Civil Affairs Handbook "East Caroline Islands," OPNAV P22-5, 1944, p. 139. See also the mimeographed report by W. R. Bascom: Ponape: A Pacific Economy in Transition (Economic Survey of Micronesia, Vol. 8), United States Commercial Company, Honolulu, 1946, pp. 68–70.

[16] Some of the larger atolls elsewhere were less fortunate in these respects. Eniwetok, for example, was an important Japanese base and was in considerable part denuded by bombing.

ownership was in question. A considerable change in internal government was necessary. A temporary United States Military Government office was established in Kusaie, but Ponape, with a more commodious harbor that makes a reasonably good seaplane landing, was selected for a more permanent Island Governments base. On the atolls, which had been relatively undisturbed by the Japanese, life went on with little change, except for the problem of reestablishing natives who had been forced to work for the Japanese in Ponape during the war.

Contrasts in Present-Day Agriculture

The greatest present-day cultural contrasts between the two island types are in their agriculture. Between 40 and 45 species of wild and cultivated plants are used for food by the natives of Ponape;[17] the list for the atolls would probably not total more than 15. The greater variety of crops in the high islands doubtless reflects in part a richer original flora; but even more it represents introductions by missionaries, Spaniards, Germans, and Japanese. Most of the new crops were not well suited to the atolls, or they would doubtless have been passed on to the small islands, but limitations of space may have been another factor that kept them out. The wide possibilities of commercial agriculture in Ponape were recognized by the Germans, and later by the Japanese, who had plans for completely colonizing Ponape with their own people. They had planted considerable areas of the best land with crops of little interest to the natives. The atolls, on the other hand, since they offered slight opportunity for the development of new crops, had an agriculture that was little different from that of pre-Japanese days. The greater agricultural possibilities of the high islands permits an easier life for those for whom sheer subsistence is enough. The atoll natives say that life is easier on the high islands, but, they add, they like the atoll climate better.

Breadfruit is the chief food crop on the high islands of the eastern Carolines but is only moderately important on the atolls. Yams rank second to breadfruit in Ponape and are important in Kusaie, but they are not grown in Mokil and Pingelap. Sweet potatoes, introduced by the Japanese, and pineapples (Fig. 5), which are especially fine in Ponape and Kusaie, are not grown at all on the atolls. Although the low islands have several varieties of bananas, the high islands have many more, the best of which will not grow on the atolls; the papaya, too, is more at home in Ponape and Kusaie than on the low islands. Cassava has long been cultivated in Ponape and was an important crop under the Japanese in both Ponape and Kusaie. Now pro-

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[17] Bascom, *op. cit.*, p. 5.

duction has declined because of lack of interest on the part of the natives; but cassava was never raised on the atolls. Corn is another crop that has found some favor on the high islands but is not known in Mokil or Pingelap. These are only a few of the host of plants that grow well on the volcanic islands but not at all or only poorly on the atolls.

Related to this circumstance is the striking dependence of the atolls on taro, especially *Cyrtosperma.*[18] The only truly cultivated crop, taro depends on an artificial soil that the islanders have carefully built up by piling leaves and other organic refuse in depressions, most of which appear to have been excavated in the distant past. These taro swamps have long been of vital importance in the lives of the atoll dwellers, and *Cyrtosperma* is unquestionably their "boss" food crop. *Cyrtosperma* is grown also on the high islands, but although these islands have natural taro swamps along fresh-water streams, the crop is of much less relative importance there.

The coconut tree is important in both types of islands but is more at home on the atolls. It is said to grow more rapidly in Mokil and Pingelap than in Ponape or Kusaie and to yield more nuts to a tree;[19] Moreover, less effort is required to keep weeds under control on the atolls, as compared with the rank growth of the high islands. Copra production on the atolls is entirely from small native holdings, whereas on the high islands several large plantations supplement the yield from native farms.

Analysis of copra production data for the four island groups is of particular interest (Table I). As would be expected, total yields are much larger for the high islands. On the other hand, the high proportion of rugged interior land there is reflected in considerably lower ratios of production to total land area. Most significant is the per capita production, which is considerably larger for the high island groups.[20] This ratio may be regarded as an index of prosperity in the eastern Carolines, since coconuts are the only cash crop of any importance. The low ratio for the atolls reflects their overpopulation and the resulting marginal existence of their inhabitants as far as purchasing power is concerned.

Pandanus is another crop that seems to thrive better on the atolls (Fig. 8). It is present in greater variety and is much more extensively used as thatching

[18] The name "taro" is often popularly applied to *Cyrtosperma Chamissonis* as well as to true taro, *Colocasia esculenta,* which is considerably less important on the atolls but is generally grown in the same swampy areas. For convenience of reference the popular usage is followed here.

[19] Bascom, *op. cit.*, p. 182.

[20] Ponape is even better off in copra production per capita than its ratio would suggest, since Ant and Pakin, which were excluded from the computations for Table I, consist largely of coconut plantations that are operated from Ponape (see footnote 14).

material, as food, and in handicrafts.[21] Arrowroot (*Tacca Leontopetaloides*), too, is much commoner in the atolls. The starch is used in various food combinations, but such use is rare in Ponape or Kusaie except where atoll natives have settled.

By way of summary it may be pointed out that much of the vegetation on the motus of the tropical Pacific consists of types that can tolerate a certain amount of brackish water. This is the case with the coconut, and also with pandanus. The papaya does not tolerate brackish water well and hence on the atolls, except in the most favored locations, is likely to have yellow leaves and other indications of unthriftiness. Taro is another crop that is somewhat intolerant of brackish water. Where motus are large enough, taro swamps are maintained in the interior without difficulty, but where the motus are too narrow and low, they may be unable to support a taro swamp.

Livestock were fairly numerous in the eastern Carolines before World War II, but their numbers are now greatly reduced. Poultry and swine, depending chiefly on coconuts and food refuse, were kept on both types of islands, but cattle were restricted to Ponape and Kusaie. It is unlikely that cattle will ever be raised on the atolls in view of the virtual impossibility of producing suitable feed for them.

Seafaring Today

The atoll people still have greater contact with the sea than the people of Ponape and Kusaie. The picturesque canoe is not now used for long inter-island travels, but the people of Mokil make whaleboats and sail them to Ponape, a hundred miles away (Fig. 11). On the station ship that plies between the island groups about once a month, native travelers from the atolls outnumber those from more populous Kusaie and Ponape. The contrast is observable, too, in fishing. All the men of the atolls are fishermen, and they do much of their fishing in the open ocean, in contrast with the high islanders, who do not venture beyond the protecting reefs. The relative ease of native fishing in the lagoons of the high islands is reflected in the prominent role played by women; on the atolls, fishing is almost exclusively men's work. Bascom points out an interesting difference in the canoes commonly used by the Ponapeans and the atoll people.[22] Since Ponapean canoes seldom go beyond the barrier reef, they are built with an unusually shallow draft,

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[21] The United States Commercial Company trader stationed in Ponape in the summer of 1947 told the writer that the best handicraft work (mats, fans, pocketbooks, etc.) though not the greatest quantity came from the atolls. He attributed the high quality of the products to greater availability of pandanus in the low islands and to better workmanship.

[22] Bascom, *op. cit.*, p. 7.

which permits them to pass over the reefs and coral heads that stud the lagoon. The atoll canoes, built for deeper water, can cross these obstacles only at high tide.

Transportation and External Relations

Transportation on the volcanic islands presents problems notably different from those of the atolls. Since roads become muddy on the high islands, the better roads are built largely of basalt. Where the roads follow the coast, streams must be bridged, and maintenance of both bridges and roads is difficult. The Germans built roads in Ponape using basalt, and the practice was extended by the Japanese. Most of these are now in bad repair, and the island government must let them deteriorate still more or else embark on an expensive construction program. As a result, most present travel is by small boats in the lagoon. The two atolls have no need for good roads, since they have no vehicular travel. All paths are based directly on the coral sand with its cover of coral fragments, and drainage is so good that a natural roadbed is available anywhere.

In external connections the high islands have an advantage. Ponape, since it has an Island Governments unit, has regular ship connections with Guam and, through Guam, with the United States. Kusaie is less well served, but on each run the station ship from Ponape goes to Kusaie, though at times it may have to by-pass Mokil or Pingelap. Ponape also has seaplane service. The waters of the Trust Territory are now open to all nations for commercial fishing. There has been talk of a Hawaiian tuna-packing concern fishing in the eastern Caroline waters, and even of other private interests operating a trading ship. Ponape, and to a smaller extent Kusaie, may benefit from such developments, but it is unlikely that the atolls will be much affected. A post office may be opened at Ponape, and Ponape, because it has an Island Governments unit, has radio connections with the outside. The possibility of some regular radio communication with Kusaie has been considered. But no such installation seems practicable for the atolls.

Contrasts in Social Patterns

In social organization, contrasts seem to be largely due to the greater populations and larger areas of the high islands.[23] For example, the clan

[23] W. R. Bascom, in an article entitled "Ponapean Prestige Economy" (*Southwestern Journ. of Anthropol.*, Vol. 4, 1948, pp. 211–221), points out an interesting complexity in the economic picture of Ponape. He distinguishes between subsistence economy, commercial economy, and prestige economy. The last is concerned with yams, pit breadfruit, kava, and pigs. For example, the Ponapean who contributes to a feast the largest yam or the oldest pit breadfruit gains a prestige that no amount of wealth could give him.

structure of Ponape, though found also in Mokil, is of little importance there. In native government the high islands are more complex. Ponape consists of five divisions or districts each of which is politically independent and has an elaborate structure of chiefs and subchiefs; Kusaie has four districts, but they acknowledge a single king (Fig. 2). The complicated native organizations of Ponape and Kusaie cause problems of modern government. Differences in faith add a further complication in Ponape; it is approximately half Roman Catholic and half Protestant, whereas the other three island groups are entirely Protestant (Congregational).

Although the high islands have considerably larger population totals, the atolls have much greater average population densities (Table I), even on the basis of usable land. Why is the population density so much lower in the high island groups? In part the very fact that the outside world was more attracted to the high islands proved their undoing. Introduced diseases not only took a toll of lives directly but, of even greater consequence, affected the birth rate through increasing sterility. A rather anomalous situation has resulted. The atolls, though not as productive in many respects as the high islands, furnished a dependable, relatively healthy existence and are now badly overcrowded. The two high islands, presenting relatively easy living conditions, have surprisingly low population densities.

The population-density contrast is reflected in turn in a land problem. Overcrowding on the low islands has reached such a level that every bit of land is owned and the buying and selling of land have long been forbidden.[24] But on the high islands there is much usable land available for settlement, and there have been no restrictions against its sale or purchase. Ponape is better off in this respect. In recent years the population of Kusaie has been recovering rapidly. Its percentage increase since 1920 has been higher than that of any of the other three island groups. This increase combined with a more rugged topography than that of Ponape means that Kusaie does not offer as great immigration possibilities. Still, compared with the two atolls, Kusaie is a land "flowing with milk and honey."

The high islands, therefore, offer the chief opportunities for future development. Mokil and Pingelap have reached their limits; they will be areas of ever increasing emigration. Planning the future so as best to promote the welfare of the native peoples of both high islands and atolls presents one of the most challenging problems facing the United States in the eastern Carolines.

[24] For a detailed study of the manner in which land is owned and inherited in Mokil see Murphy *op. cit.*

THE ASIATIC IMMIGRANT COMMUNITY IN THE UNION OF SOUTH AFRICA*

KEITH BUCHANAN AND N. HURWITZ

THE South African Asiatic community is an outstanding example of an immigrant group of tropical origin, which was originally imported to meet the labor requirements of European settlers and which has aroused bitter opposition by its attempts to move outside its allotted sphere. Like the Jews in Eastern Europe during the nineteenth century, this immigrant community has been confined by social and legislative pressure to a restricted geographical area and to certain fields of economic activity, and this territorial and economic concentration (scarcely of its own choosing) has been the basis of further criticism.

It is a community showing a high degree of cultural diversity, reflecting its diverse origins, and, although Asiatics have been established in the Union for more than 80 years and although 80 per cent of the present Asiatic population were born in South Africa, the division between the various cultural groups has lost little of its original sharpness.

Demographically, the Asiatic group is of interest because it offers an example of a tropical immigrant community with potentialities for very rapid growth established alongside a European immigrant community of relatively low and declining growth potential.

HISTORICAL RETROSPECT

The genesis of the "Asiatic problem" in the Union, and in Natal in particular, lay in the needs of the sugar industry in the subtropical coast belt of Natal. By the middle of the nineteenth century the industry had become firmly established, and further expansion was limited only by the shortage of labor. There were, it is true, some 100,000 natives resident in Natal, yet despite taxation and the inducement of money wages, they could not be enticed from the reserves created by Theophilus Shepstone, nor could they discipline themselves to engage in regular work involving a wage contract. Failing to recruit local labor, the sugar planters and other colonists turned

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*Ninety-seven per cent of the Asiatic community speak Indian languages, and the terms "Indian" and "Asiatic" are used interchangeably in the Union.

➤ MR. BUCHANAN, formerly of the University of Birmingham, England, and in 1946–1948 assistant lecturer in geography at the Natal University College, was recently appointed head of the department of geography, University College, Ibadan, Nigeria.

MR. HURWITZ is lecturer in economics at the University of Natal. Both authors are interested in land use, and they are collaborating on an agricultural atlas of Natal.

their eyes toward the teeming East, and especially toward India, which had already furnished indentured labor to other sugar-growing colonies, such as Mauritius. Petitions to the local legislature were favorably received, and the consent of the Colonial Secretary to the introduction of indentured "coolie" labor was obtained; the reluctance of the Indian government to allow such emigration was eventually overcome, and in 1859–1860 legislation permitting the introduction of Indian labor into Natal was carried. Immigrants were to complete five years as indentured laborers and at the end of ten years would be entitled to a free passage to India or, alternatively, to the grant of crown land. The second provision, however, was never implemented, and few availed themselves of the first.

In 1870 the Asiatic population was only 6000; but as the colony grew, the demand for labor increased, restrictions on Indian immigration were removed, and the Asiatic population swelled, between 1874 and 1885, by some 34,000. Many of the immigrants preferred to become small market gardeners or traders rather than plantation workers, and their numbers were swollen by indentured Indians who had become "free" and had drifted away from the cane fields. So strong was their competition with Europeans, especially in the commercial sphere, that a violent outcry was raised against further immigration, and in 1896 the Natal Legislature, yielding to the pressure of the European population, prohibited the free entry of Indians. In 1913, three years after the unification of South Africa, the Union Legislative Assembly finally closed the gates to Asiatic immigration, except for the wives and children of Asiatics domiciled in the Union.

Population Growth and Numerical Relationship to the Other Communities

Today 84 per cent of the Union's Asiatic population is concentrated in the province of Natal. The growth of this population and its relation to the whole are summarized in Table I. By 1904 the Asiatic population exceeded

Table I—Growth of Population in Natal 1870–1946

YEAR	EUROPEAN	ASIATIC	NATIVE	ASIATICS AS % OF IMMIGRANT GROUPS	ALL RACES
1870	14,445	6,000	..	37.9	..
1891	46,788	41,142	..	46.8	..
1904	97,109	100,918	904,041	51.0	9.2
1911	98,114	133,439	953,398	57.6	11.3
1921	136,838	141,649	1,139,804	50.9	10.0
1936	190,549	183,661	1,553,629	49.0	9.5
1946*	232,923	228,119	1,669,068	49.4	10.4

*Figures for 1946 are based on provisional figures released by census authorities and published in the South African Press, Aug. 13, 1946.

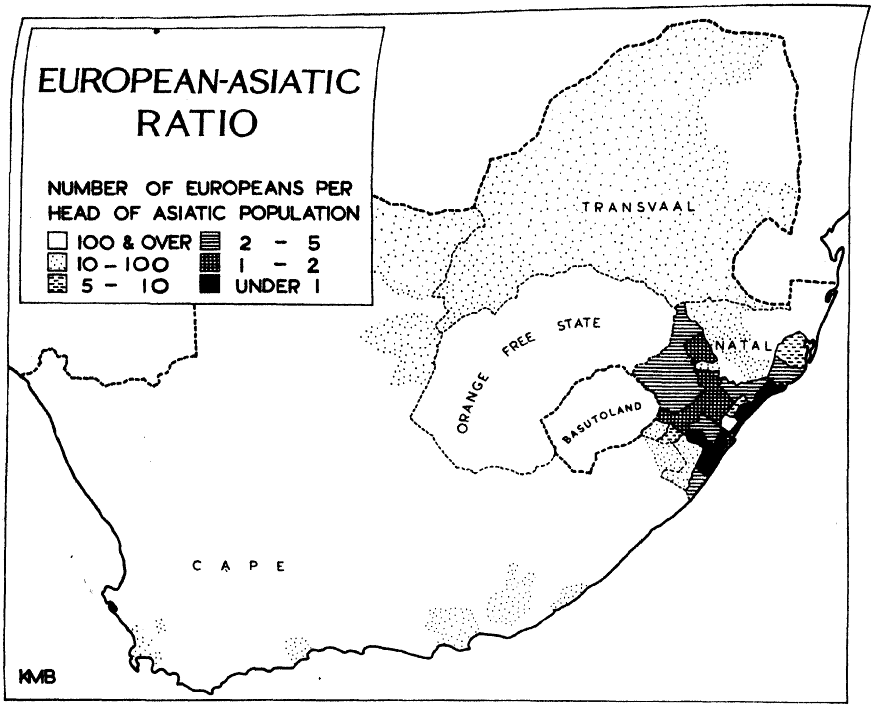
EUROPEAN-ASIATIC RATIO
NUMBER OF EUROPEANS PER HEAD OF ASIATIC POPULATION
100 & OVER
10 – 100
5 – 10
2 – 5
1 – 2
UNDER 1
TRANSVAAL
ORANGE FREE STATE
NATAL
BASUTOLAND
CAPE
KMB

FIG. 1

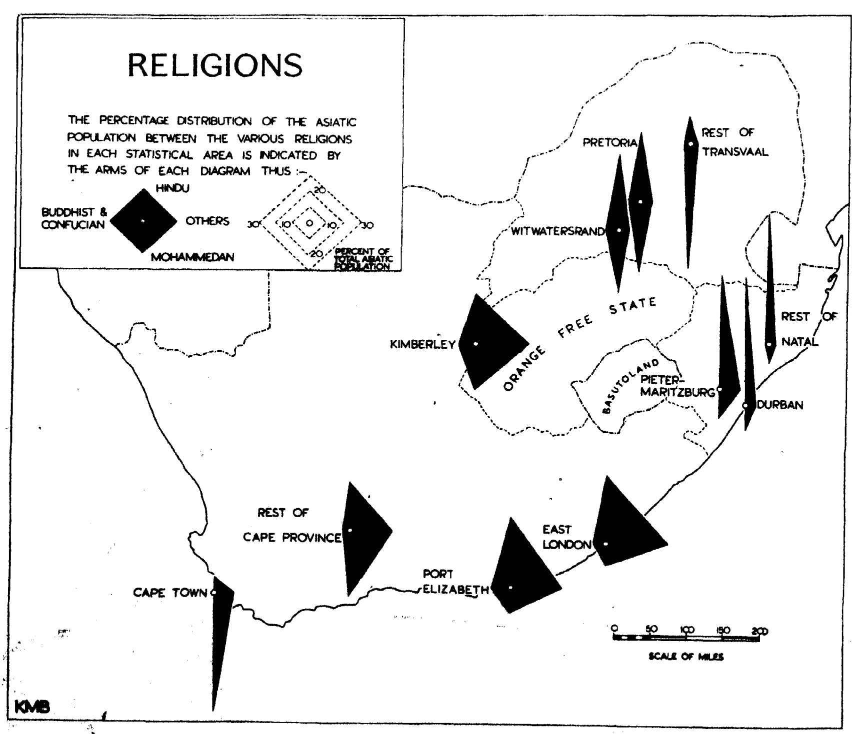
RELIGIONS
THE PERCENTAGE DISTRIBUTION OF THE ASIATIC POPULATION BETWEEN THE VARIOUS RELIGIONS IN EACH STATISTICAL AREA IS INDICATED BY THE ARMS OF EACH DIAGRAM THUS :—
HINDU
BUDDHIST & CONFUCIAN
OTHERS
MOHAMMEDAN
PERCENT OF TOTAL ASIATIC POPULATION
PRETORIA
REST OF TRANSVAAL
WITWATERSRAND
KIMBERLEY
ORANGE FREE STATE
BASUTOLAND
PIETER-MARITZBURG
DURBAN
REST OF NATAL
REST OF CAPE PROVINCE
CAPE TOWN
PORT ELIZABETH
EAST LONDON
SCALE OF MILES
KMB

FIG. 2

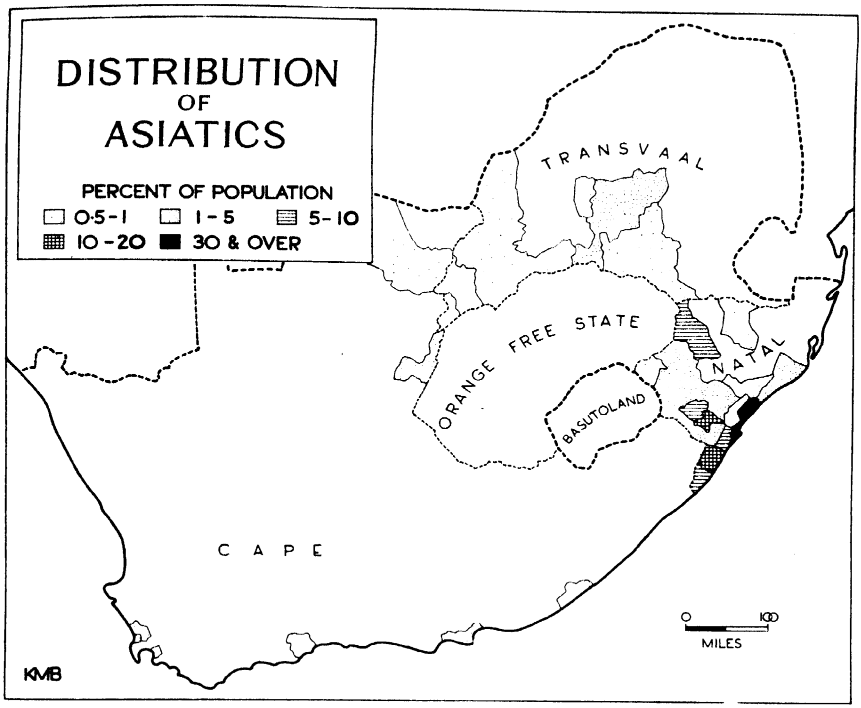
DISTRIBUTION
OF
ASIATICS
PERCENT OF POPULATION
0·5-1
1-5
5-10
10-20
30 & OVER
TRANSVAAL
ORANGE FREE STATE
BASUTOLAND
NATAL
CAPE
0
100
MILES
KMB

FIG. 3

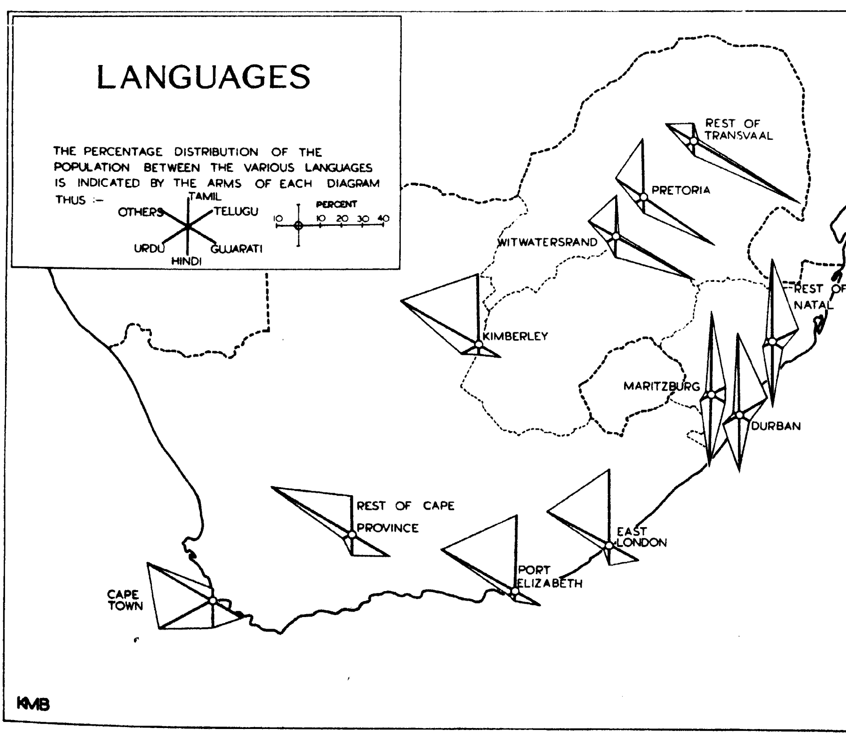
LANGUAGES
THE PERCENTAGE DISTRIBUTION OF THE POPULATION BETWEEN THE VARIOUS LANGUAGES IS INDICATED BY THE ARMS OF EACH DIAGRAM THUS :-
TAMIL
OTHERS
TELUGU
URDU
GUJARATI
HINDI
PERCENT
10
10 20 30 40
REST OF TRANSVAAL
PRETORIA
WITWATERSRAND
KIMBERLEY
REST OF NATAL
MARITZBURG
DURBAN
REST OF CAPE PROVINCE
EAST LONDON
PORT ELIZABETH
CAPE TOWN
KMB

FIG. 4

the European population, and it attained its greatest relative importance in the years preceding World War I; in 1911 it outnumbered the European population by some 35,000. Since that date it has declined in importance relative to both the European and the total population.

TABLE II—ASIATIC POPULATION OF THE UNION 1904–1946

PERCENTAGE OF	1904	1911	1921	1936	1946
Immigrant groups	9.9	10.7	9.8	11.0	10.7
All races	2.4	2.54	2.4	2.3	2.5

The position of the Asiatic community in the Union is given in Table II. Excluding Natal, it is evident that the proportion is very low; in fact, it is less than one two-hundredth of the total. Only in small areas of Natal do Asiatics form more than one-twentieth of the total population. These districts together make up slightly more than 1 per cent of the Union. The percentages (1936) are:

Inanda	51.88	Lower Tugela	33.26	Pietermaritzburg	12.50	Lions River	7.37	Port Shepstone	6.82
Durban	33.81	Umzinto	12.70	Pinetown	9.76	Dundee	6.98	Newcastle	5.99

Inanda, Durban, Lower Tugela, and Port Shepstone are sugar districts; Dundee and Newcastle are mining districts. In only one district, Inanda, did Indians constitute an actual, if slight, majority.

Since, however, the economic and political conflict is largely between Indian and European, rather than between Indian and Bantu, the ratio between total population and Asiatic population is of less significance than the European-Asiatic ratio (Fig. 1). Again, it is only in Natal that the Asiatic group attains or even approaches numerical superiority. In 24 out of the 44 districts (1936) of Natal the ratio between Europeans and Asiatics is lower than 5 to 1; in 13 districts it is lower than 2 to 1; in 6 districts—Mtunzini, Lower Tugela, Inanda, Pinetown, Umzinto, and Richmond—the Indian population exceeds the European population. As a result, however, of the widely different fertility levels of the European, Asiatic, and Bantu communities, the balance between them is gradually changing, mainly in favor of the non-European groups.

GEOGRAPHICAL DISTRIBUTION OF THE ASIATIC POPULATION

In 1936, 83.6 per cent of the Asiatic population of the Union were in Natal, 11.6 per cent in the Transvaal, and 4.8 per cent in the Cape. In Cape Province, with the exception of the diamond area around Kimberley, the chief Asiatic communities are peripheral: somewhat more than half of the total live in the ports of Cape Town, Port Elizabeth, and East London.

In the Transvaal the main concentration is in the south, with two-thirds of the total in the Witwatersrand and Pretoria region. In Natal there is a fair sprinkling of Asiatics in the northern coal-mining area around Newcastle, but the main concentration is in the cities of Durban and Pietermaritzburg and in the coast belt. Here, in fact, is the greater part of the Union's Asiatic population; Durban[1] and Pietermaritzburg alone contain some 48 per cent of the total, and a further 26 per cent live in the coastal districts north and south of Durban.

The concentration in Natal is due partly to geographical factors, such as the suitability of the subtropical coast belt for intensive market gardening, but probably the most important factor has been legislation[2] prohibiting Indian movement across the provincial borders. This has prevented the diffusion of the Asiatic group through the Union.

The relative distribution, as between town and country, of the four so-called "racial" groups and of the total population is given in Table III. The

TABLE III—URBANIZATION BY CULTURAL GROUPS, 1936

	UNION	CAPE	TRANSVAAL	NATAL
All races	31%	31%	39%	21%
Europeans	65	64	69	76
Natives	17	11	28	8
Colored	54	52	74	67
Asiatics	66	97	86	62

high degree of urbanization of the Asiatic population in the Cape and the Transvaal as compared with Natal is associated with the contrasts in economic activities—trading predominating in the first two, a large proportion engaged in market gardening and fruitgrowing in Natal.

CULTURAL DIVERSITY

The Asiatic population of the Union is by no means homogeneous. The original immigration consisted of diverse linguistic and religious elements, and economic status varied widely. In spite of several decades of outside pressure, cultural and economic cleavages remain strong. Perhaps the strongest is the religious. In the Union as a whole, 72.7 per cent of the total Asiatics were Hindus, 19.4 per cent Mohammedans, and 4.9 per cent Christians; Buddhists made up only 0.8 per cent. Table IV gives the regional contrasts.

A more detailed picture of the religious affiliations of the Asiatic population is given in Figure 2. Cape Town's Asiatic community is predominantly

[1] Including the suburban district of Pinetown.

[2] Notably the Immigrants Regulation Act of 1913.

Mohammedan; in the other urban centers of Cape Province, Hindus and "others" (Buddhists, Confucianists, etc.) are strongest, though there are important Catholic minorities in Kimberley and Port Elizabeth. In Pretoria and the Witwatersrand the Asiatic population is divided equally between

TABLE IV—RELIGIONS OF THE ASIATIC COMMUNITY

RELIGION	UNION	CAPE	TRANSVAAL	NATAL
Christianity	4.9%	19.0%	4.7%	4.2%
Hinduism	72.7	28.9	36.4	80.3
Mohammedanism	19.4	43.8	51.5	13.5
Buddhism and Confucianism	1.6	5.9	5.2	0.9

Hinduism and Mohammedanism, but the rural population of the Transvaal, chiefly traders, is overwhelmingly Mohammedan. Natal is dominantly Hindu, most markedly so in the rural areas.

The linguistic diversity of the Asiatic population is shown in Table V. The points that stand out are the contrast between Natal, where the South Indian languages are dominant (85 per cent), and the Transvaal, where the

TABLE V—HOME LANGUAGES OF THE ASIATIC COMMUNITY

LANGUAGE	UNION	CAPE	TRANSVAAL	NATAL
Tamil	37.63%	21.53%	18.38%	41.23%
Hindi	27.20	9.92	8.74	30.75
Telegu	11.26	0.64	0.86	13.33
Gujarati	11.71	16.39	50.04	6.11
Urdu	6.44	12.85	5.28	6.24
Other Indian	2.00	3.86	4.70	1.53
Chinese	1.25	10.33	6.22	0.03
European	2.07	21.79	4.77	0.56

North Indian languages are dominant, and the relatively high proportion of the Cape Asiatics who have adopted a European language as their home language. The linguistic composition of the Asiatic group in the major urban centers of the Union is given in more detail in Figure 4. In Cape Province there are marked contrasts between Cape Town itself, where the dominant languages are Urdu and "others" (including European languages), and the rest of the province, where the dominant languages are Tamil and "others." Gujarati is dominant throughout the Transvaal, but its importance increases, like that of Mohammedanism, in the rural areas. Natal shows a fair balance between Tamil and Hindi; Tamil speakers are mainly concentrated in the coast belt, where from the Umfolosi in the north to Port Shepstone in the south and as far inland as Pietermaritzburg more than two-fifths of the Asiatic population speak Tamil.

There is a strong correlation between language and religion among the Asiatics, so that the cultural barrier between the various groups is twofold.

Almost the entire Urdu-speaking population and almost three-quarters of the Gujarati-speaking population are Mohammedan; between 80 and 90 per cent of the groups speaking Tamil, Hindi, and Telegu profess Hinduism; about one-half of those using a European language as their home language are Mohammedan, two-fifths Christian, and one-tenth Hindu.

The Economic Role of the Asiatic Community

Lack of educational opportunities combined with restrictive legislation has compelled the Asiatic community to concentrate its activities in certain occupational groups (Table VI). Agriculture, manufacturing, commerce and finance, and personal services together account for some 85 per

Table VI—Occupations of Europeans and Asiatics in the Union, 1936

Occupational group	Europeans		Asiatics	
	Number	%	Number	%
Agriculture, forestry, fishing	181,409	24.83	18,056	28.12
Mining, quarrying	46,936	6.42	862	1.34
Manufacturing	136,629	18.15	11,438	17.81
Transport and communications	77,830	10.65	1,617	2.52
Commerce and finance	119,006	16.29	17,263	26.89
Public administration	81,282	11.13	3,079	4.80
Professions	39,875	5.46	694	1.08
Sport and entertainment	3,406	0.47	296	0.46
Personal services	30,528	4.18	7,646	11.91
Other	17,760	2.42	3,255	5.07

cent of the total Asiatic working population, as compared with 63 per cent of the European.

Significant contrasts in the economic structure of the Asiatic community in the various provinces are due to legislation rather than to geographical factors. Because of restrictions on landownership in the Cape and the Transvaal, very few Asiatics engage in agriculture there, and as the skilled trades are practically closed to them, the main economic outlet for Asiatics in these two provinces is in commerce: 65 per cent of the Asiatic working population of Cape Province and 71 per cent of that of the Transvaal were engaged in commerce and finance in 1936 (for Natal the percentage was 15). Thus the position of the Indian in parts of the Union is similar to that of the Jew in Eastern Europe: both have been restricted to certain occupational groups; both have been economically indispensable;[3] both have been the object of resentment on the part of other, competing, sectors of the community in which they find themselves.

Although many Asiatics are engaged in commerce on a large scale, the

[3] It is interesting to note that in the parts of the Union where Asiatics have not penetrated to any large extent much of the trade is in the hands of Jews.

great majority are small-scale traders and dealers. In 1937–1938, out of some 15,000 trading licenses issued to Asiatics, 50 per cent went to general dealers or fresh-produce dealers, 32 per cent to peddlers and sellers of patent and proprietary medicines, 4 per cent to keepers of tearooms and eating houses, and 1.4 per cent to companies. There can be no question that the Asiatic trader in the Union, like the Chinese trader in Southeast Asia or the Jewish trader in Eastern Europe, has provided a valuable economic service in the distribution of commodities, especially in the less accessible rural areas. But his very success has focused attention on him and has given rise to much resentment and jealousy among the other sectors of the community seeking to enter the distribution trades. Even in Natal, however, Europeans outnumber Asiatics by 2 to 1 in commerce and finance; in the other two provinces the ratio is even more heavily in favor of the European—7 to 1 in the Transvaal, 16 to 1 in the Cape.

Virtually the entire Asiatic population of the Union engaged in agriculture is in Natal, where Asiatics thus employed outnumber Europeans by 2 to 1. This concentration is due partly to the opportunities offered by the sugar industry, but even more important has been the absence in the past of any legal bar to Asiatic landownership. Competition between the two groups can scarcely be said to exist in agriculture, for the Asiatic is typically either a field laborer or a small-scale market gardener: in 1936, out of some 18,000 Asiatics engaged in agriculture in the Union, one-half were laborers and two-fifths small farmers or market gardeners. In manufacturing, however, growing competition from the Asiatic can be expected, though the so-called "civilised labour policy" and lack of opportunity for training have tended to confine him to the unskilled trades, so that more than one-half of the total employed in industry in 1936 were classed as "unskilled industrial laborers." Of the total number employed, one-half were engaged in the textile and food industries; no less than one-tenth of the total were tailors.

Demographic Characteristics of the Asiatic Community

Demographically, the Asiatic community is remarkable for two features: its comparatively high masculinity, and the large proportion of the total population in the younger age groups.

In the Union as a whole, the Asiatic community in 1936 showed a masculinity rate of 118, as compared with 103 for the Europeans and 101 for the natives. This abnormal sex ratio is a legacy from the past when the vast majority of immigrants were men; consequently the masculinity rate is especially high in the older age groups (more than 250 in each of the

quinquennial age groups between 50 and 70) but is comparatively normal in the younger age groups, with an actual excess of females in the 0–4 group. The appreciable drop in the masculinity rate in the 1921–1936 intercensal period (from 139 to 118) points to the gradual stabilization of the Asiatic community;[4] it is significant that the ratio was closer to normal in the older-settled province of Natal (112) than in the Transvaal or the Cape (respectively 152 and 174).

The age composition of the population is particularly important, since it will largely determine the future growth of the Asiatic community. Contrasts between the European and Asiatic groups are summarized in Table VII.

TABLE VII—AGE COMPOSITION OF THE EUROPEAN AND ASIATIC COMMUNITIES, 1936

AGE GROUPS	UNDER 10	10–19	20–39	40–59	60 AND OVER
Europeans	21.1%	19.7%	32.0%	19.2%	8.0%
Asiatics	32.4	23 9	26.4	12.9	4.3

The large proportion of the Asiatic population in the youngest age groups is striking: whereas in 1936 only 10.5 per cent of the total European population were in the under-five age group, in the Asiatic population 15 per cent of the males were in this group and no less than 18.4 per cent of the females. In Natal the number of European children in the under-five age group was 16,720, of Asiatic children 30,923. The contrasts in fertility ratios[5] between the European and Asiatic groups are equally striking. In Natal the number of children under five per 1000 women of child-bearing age was 815 for Asiatics, as against 323 for Europeans; it is of interest that the Asiatic figure is some 50 per cent above the Egyptian figure, usually regarded as extremely high (the Bantu figure was 574). These features of concentration in the younger age groups and high fertility ratio mean that the Asiatic population has potentialities for very rapid growth if the present checks in the form of malnutrition and disease and high infant mortality[6] are removed; politically they are important because it is problematical in the extreme how far the present restrictions, both territorial and economic, will be able to survive in the face of a rapidly increasing Asiatic population.

[4] On the basis of the provisional figures of the 1946 census the masculinity rate dropped from 118 to 108 in the decade 1936–1946.

[5] Children under five per 1000 women in the age group 15–49.

[6] In 1945 twice that of the European population.

OBSERVATIONS IN KAMISHAK, ALASKA*

WILL F. THOMPSON, JR.

THE Cook Inlet area, including the Kenai Peninsula and the eastern part of the Alaska Peninsula, is the junction of four corridors along which geographic influences have come: the Arctic tundras, the maritime tundra islands of the Aleutian chain, the Hudsonian forests of the interior, and the forested fiord coast. The area is best characterized as a transition zone between the two maritime areas, the homes of the Aleut and of the northwest-coast Indians. Into this transition zone two other cultures extended, each widespread elsewhere. Across the Alaska Peninsula by way of the Savonoski-Katmai portage and the Iliamna portage the Eskimo traveled back and forth from the permafrost tundras of the Bering Sea coast to Kodiak Island and the outer islands of the Kenai Peninsula. On upper Cook Inlet the Athabaskan-speaking Indians of the interior made their westernmost contact with the sea. Their corridor was the Susitna Valley, along which the climate and flora of the interior also reached the coast.

The Cook Inlet focal region is likewise the key to the future of American settlement in Alaska. Important rail and highway routes to the interior pass through Anchorage, at the head of the dubious navigation of the inlet. Nevertheless, the position of Anchorage as the metropolis of Alaska seems most of all assured by the fact that it is the only city on the Pacific coast of Alaska well enough situated as regards terrain and climate to take care of the relatively enormous air traffic that has become the lifeblood of the Alaskan economy. It seems inevitable, therefore, that any economic organism which may grow up as a basis for full and permanent American settlement in Alaska will have to center on Cook Inlet.

The means for settlement are not entirely obvious at the present time. Whether goods are moved by land, sea, or air, the distances covered and the dispersion of the population make high freight rates inevitable. Even if the distances could be reduced, it would not be desirable to do so, because they are as much an opportunity as a handicap. Given these distances, economy in Alaskan transport can be furthered by two means. In the first place, the efficiency of the vehicles has been improving steadily and will continue to improve. In the second place, continued settlement would tend to pro-

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*Dr. John C. Reed, Staff Geologist, Territories and Island Possessions, United States Geological Survey, has kindly read the manuscript.

➤ MR. THOMPSON has spent two winters in oceanographic work off the Queen Charlotte Islands and two summers in the western Aleutians as assistant to a member of the United States Geological Survey; his earlier war service also took him to the Aleutians.

duce a market for bulk goods, instead of the highly assorted goods and services required to maintain the present small communities.

As a dependency of a country with so highly developed and well-balanced an economy as that of the United States, Alaska has found only two industries capable of producing major exports to balance its imports from the parent country. One of them, mining, has been declining as a population-supporting activity. The other, fisheries, is in a good position to use transient labor and outside bases of supply. The present commerce, industry, and agriculture of the Territory are in the nature of services to the two dominant industries. The greatest hope for settlement at the present time lies in the need for foodstuffs. High freight rates have enabled the sub-Arctic soil to compete with that of more favored latitudes to some extent, but nobody has made any fortune out of Alaskan farming yet.

The following paper is concerned with one of the better areas available for settlement after the Cook Inlet areas now being homesteaded are all taken up. Its problems are of the same nature as, and not greater than, those of any place not yet occupied at least in part. If Anchorage is to develop a hinterland large enough to support it as a really efficient center of distribution, then it must be possible to settle Kamishak Bay. The opportunity to make the study of which this paper is an incidental product came when I was offered employment with a party working on the Alaska Peninsula in the summer of 1948.

"Why hasn't this place been settled?" A traveler in Alaska often finds himself asking that question, and it has seldom had more force for me than in the Kamishak Bay area last summer. In many parts of the Territory—in the glaciated mountains, in the Arctic, among the fiords of the southeast—the answer is easy. On the Kamishak the reason is not so apparent, because there is little doubt that the sheltered valley is physically favorable to agriculture.

Kamishak Bay lies about 200 miles southwest of Anchorage and about 80 miles west of Seldovia, on a much-used air route from Anchorage or Kodiak to Naknek, on an arm of Bristol Bay, and to the Aleutians. In good weather the planes fly contact directly over the valley; in bad weather they are tied more closely to the beam. Cook Inlet shipping often passes within 40 or 50 miles of the bay but usually comes no nearer, for lack of reason and because of the nature of the shore. A United States Geological Survey party made an overland reconnaissance through the area in 1923.[1] They

[1] K. F. Mather: Mineral Resources of the Kamishak Bay Region, *in* Mineral Resources of Alaska ..., 1923, by A. H. Brooks and others, *U. S. Geol. Survey Bull. 773*, 1925, pp. 159–181.

occupied one or more stations in the neighborhood and gave native names to various landmarks. At that time the prospector Charles McNeil was living at McNeil Cove; since his death there have been no permanent residents of the inner bay. A trapper's shack, unused since some years before World War II, still stands several miles up the Big Kamishak River. We found traces of cut trail, an old campsite, and the ruins of a trap-line shelter, so that the region, though certainly little known, has not been without visitors.

Kamishak Valley Setting

Kamishak Bay is an arm of Cook Inlet. At its southeast corner and forming the eastern tip of the volcanic range of the Alaska Peninsula is Mt. Douglas (7064 feet). Southwestward the peaks of the range include Four Peaked Mountain (6903 feet), an unnamed small caldera with a fine crater lake behind Kaguyak Cove, the magnificent spire of Devils Desk (6340 feet), the broad mass of Mt. Denison (7630 feet), Snowy Mountain (7108 feet), Knife Peak (7585 feet), and Katmai, once 7500 feet but now only a tremendous stump. There are also a great many smaller peaks, all unnamed, some of them extremely rugged and brilliantly colored, probably as a result of hydrothermal alteration of the rocks. The range shelters the Kamishak Valley and the upper Savonoski Valley on the Pacific side.

The passes between the Kamishak and Savonoski watersheds lie on a dissected plateau that flanks the volcanic range between the Kaguyak and Douglas River drainage basins and extends to the sea between the mouths of the Kamishak and Douglas Rivers. From the south shore of Kamishak Bay the plateau margin rises in magnificent cliffs. The shelter afforded by the 2000-foot scarp of the plateau is a large factor in the climate of the valley.

The main axis of the Aleutian Range becomes distinct from the line of volcanic peaks in the Naknek Lake area; its characteristic granitized conglomerates appear in the peaks south of Iliuk Arm of Naknek Lake. It extends from there along the height of land toward the Iliamna Lake portage. On this line, west of the Kamishak Valley, is a fine group of closely set small granitic peaks with summit levels at nearly 5000 feet, to which I shall refer in this paper as the Alpine Group.

The Kamishak Valley, thus enclosed between two mountain ranges, drains north into Kamishak Bay. The mouth of the valley faces Mt. Iliamna, with the Iliamna Lake portage area in between. Augustine Volcano, a nearly perfect volcanic cone, which was active in the last years of the nineteenth century, rises from the water between the bay and Cook Inlet proper. It has little effect on winds entering the valley from the inlet. As a matter of fact, all the bad weather we had in the valley itself during the summer came

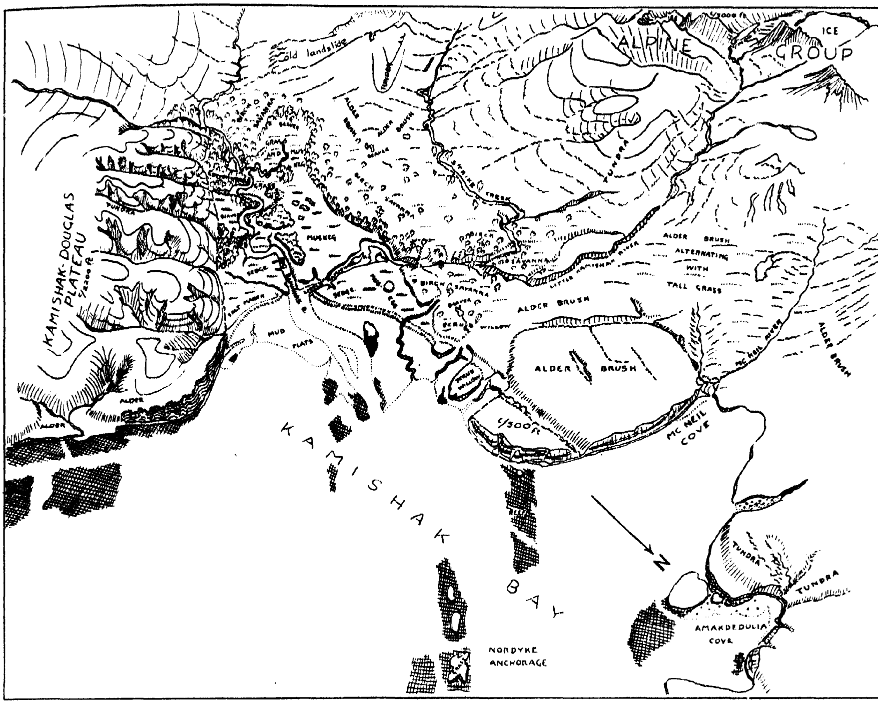

FIG. 1—Author's diagrammatic sketch of the Kamishak Valley area.

FIG. 2—The general setting of the Kamishak Valley area. Reproduced on about half scale from Erwin Raisz's "Landform Map of Alaska" for the Office of the Quartermaster General, 1 : 2,500,000.

FIG. 3—The Kamishak Valley. Reproduced in black and white on a slightly reduced scale from the U. S. Geological Survey sheet Kamishak Bay—Katmai Region, Alaska, scale 1 : 250,000. 1938.

FIG. 4—Valley of Kamishak River. View south-southeast from over tide flats at the southwestern end of Kamishak Bay at approximately 59° 02′ N., 154° 12′ W. (a) South Fork of Kamishak River; (b) Douglas River; (c) Devils Desk, 6340 feet. (Trimetrogon aerial photograph by U. S. Air Force, July 31, 1942.)

with winds that had a marked northerly component on the ground, though the winds aloft may have been something else. Winds from other sectors necessarily descend from the summits of the ranges and have decided foehn characteristics.

Aerial photographs of the Kamishak area taken in winter show all of it under deep snow. The vegetation confirms the photographic evidence. It would be interesting to know whether the snow derives from air masses entering the area from the Pacific or from Bering Sea. Interaction of one or the other with cold air masses coming down Cook Inlet, which would tend to turn westward, is probably the immediate cause. The Homer area, directly across the inlet, has much less snow.

Spring at Homer

Before crossing Cook Inlet to start work in the Kamishak, we settled down at the hotel at Homer to await weather for a reconnaissance flight. Spring was well under way. The snow line had retreated to the higher tablelands of the Kenai. The south-facing scarp behind the town and its alluvial fans were still black from fires set to clear off excessive ground cover, so that the ground would warm quickly. The effect of repeated burning was obvious in recently deepened gullies and new deposits of washed soil on the fan heads. On the Kamishak side we were to see how necessary preburning is to agriculture in a sub-Arctic region. Nevertheless, it should be possible to use some other technique after the first few years.

The best-established homesteads at Homer lay east of the town on the alluvial fans, facing the sun. The buildings were substantial and well painted. Newly plowed fields were a rich-looking brown loam. A few cattle in the fields appeared sturdy. In several meadows were racks for drying hay in the Scandinavian way. We were told that the homesteaders depend on the salmon fisheries for a cash income; during the fishing season, which lasts practically all summer, they leave the farming to be done by their families.

The only obvious markets for Homer's farm products are ones in such places as Seldovia and the rapidly developing Anchorage metropolitan area. A great deal of homesteading is under way in the vicinity on the assumption that completion of highway connections to Anchorage will boom land values. Most of the new homesteads on the tableland and to the west, along the shore of the inlet, have less favorable-looking sites than the established ones described above. Trucking to Anchorage will almost certainly be expensive and may have doubtful advantages over air freight.[2]

[2] See Walt Pedersen's "Homesteading in the Homer-Kenai Area," 1948. Alaska Map Service, Box 2198, Anchorage, Alaska.

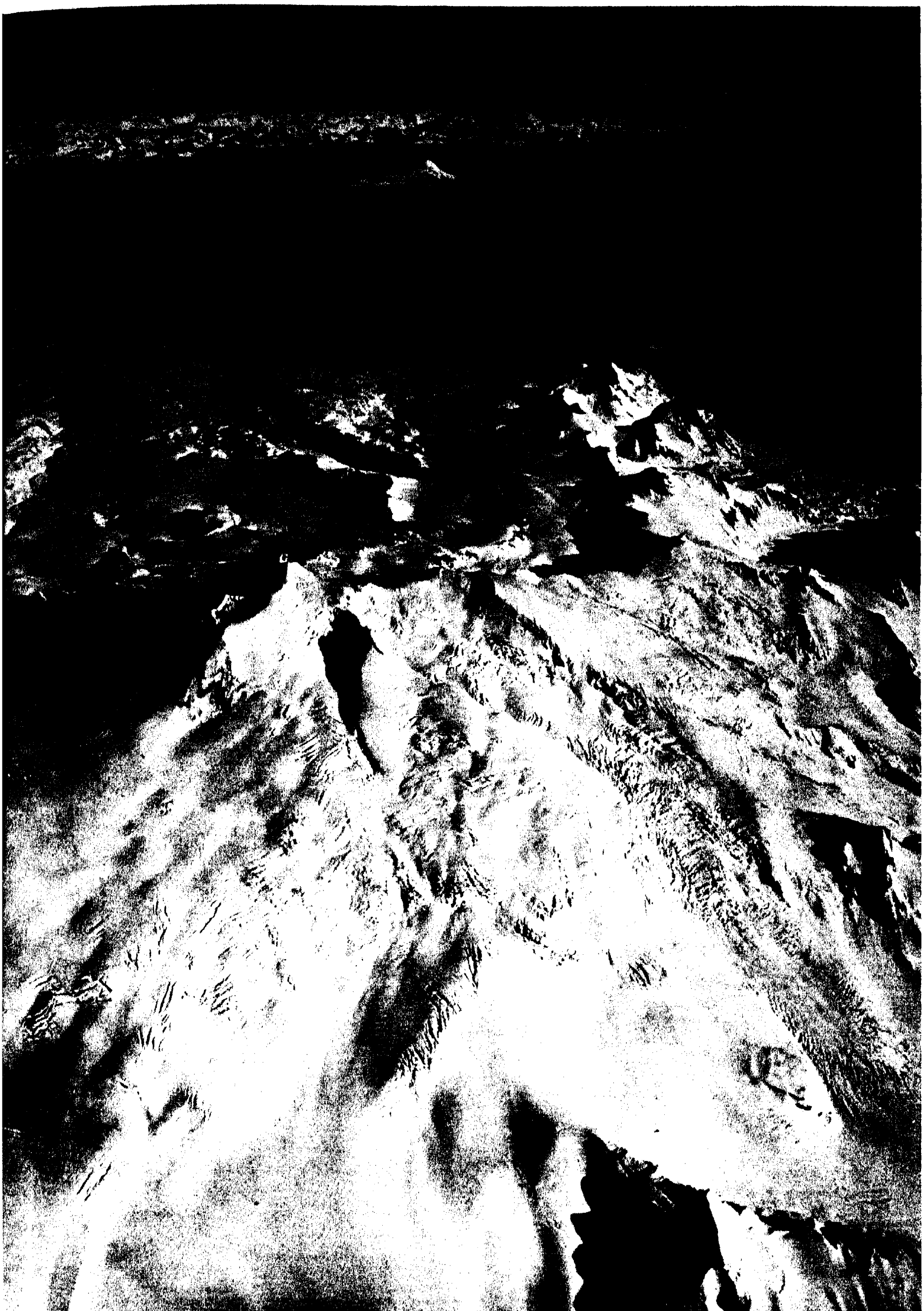

FIG. 5—View north from approximately 58° 50′ N., 153° 31′ W. Mt. Douglas, 7064 feet, in foreground; Kamishak Bay at distant left; Cook Inlet at right; Augustine Island in distant center; Aleutian Range, west of Cook Inlet, in far distance. (Trimetrogon aerial photograph by U. S. Air Force, April 7, 1943.)

FIG. 6—Lower valley of Kamishak River. View east from approximately 58° 56′ N., 154° 22′ W. Strike Creek in foreground, valley of Kamishak River in middle distance, and Mt. Douglas at distant right. (Tri-metrogon aerial photograph by U. S. Air Force, Sept. 23, 1946.)

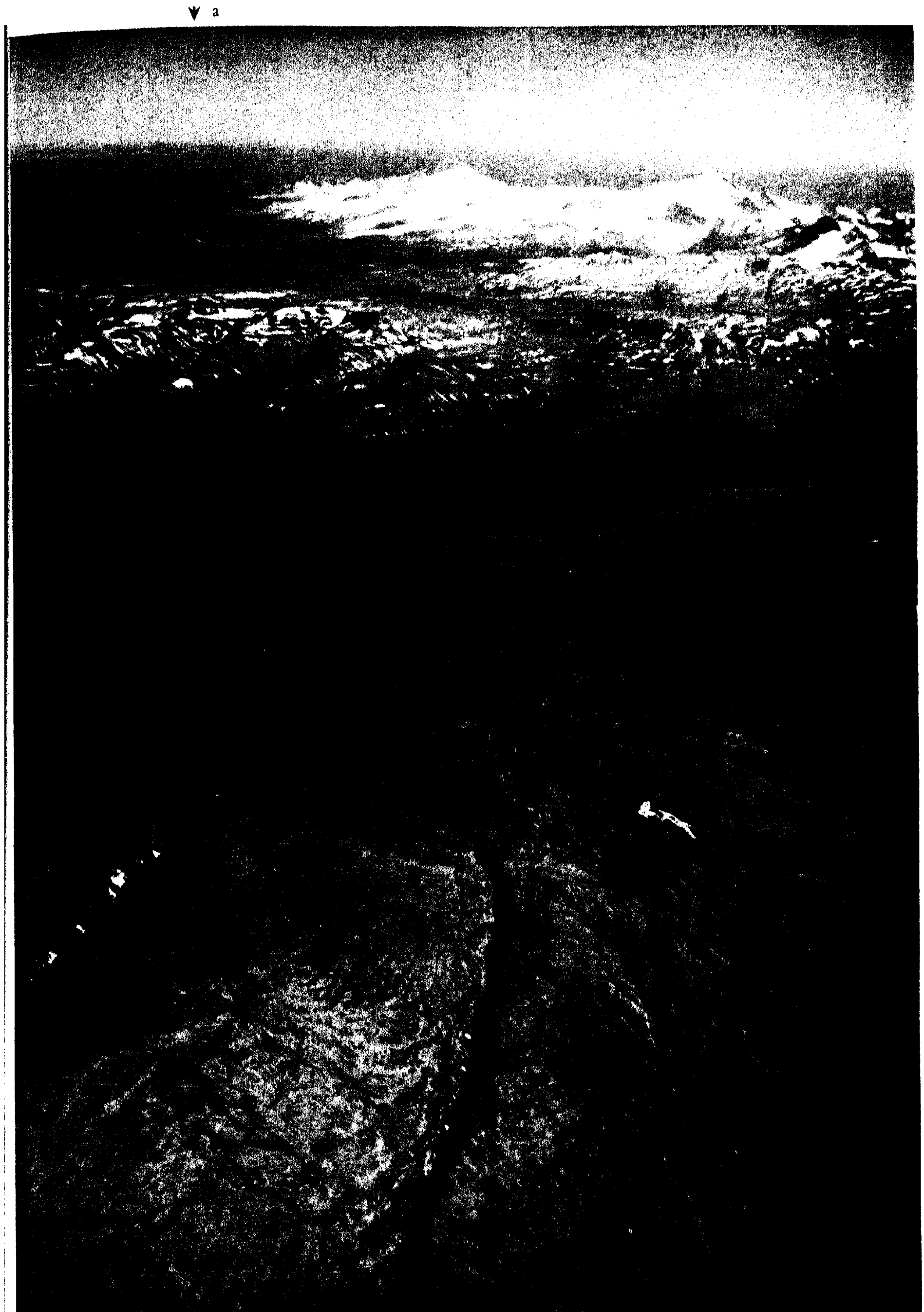

FIG. 7—Upper valley of Kamishak River. View east from over ridge between the valleys of Kamishak River and Strike Creek at approximately 58° 51′ N., 154° 21′ W. (a) Junction of Kamishak River and South Fork; (b) Valley of Douglas River. Mt. Douglas in distant center and Fourpeaked Mountain at right. (Tri-metrogon aerial photograph by U. S. Air Force, Sept. 23, 1946.)

RECONNAISSANCE FLIGHT OVER KAMISHAK

With the advent of fairly good flying weather I had my first opportunity to study the Kamishak from the air. The flight took us across Cook Inlet, past Augustine Volcano, still heavily frosted with fog deposit.[3] The crater is occupied by an unusually well developed plug dome. On the bottom of the inlet around the mountain are scattered large boulders, which may well have originated in the explosion of an earlier plug; the danger of running into such boulders in the shallow waters around the volcano has been a deterrent to navigation in Kamishak Bay. Similar boulders in some of the coves inshore are glacial erratics rather than volcanic blocks. In the summer of 1948 an Anchorage company resumed attempts to use pumice from the slopes of the cone as light-weight aggregate for structural forms of insulating cement; the material was shipped from a small and difficult harbor on the north shore of the island.

The inner bay looked fairly inviting only because high tide covered the broad reefs that are dangerous to a vessel attempting to navigate without good charts and precise positions. Unfortunately, there are no good charts yet, and thick weather is far from infrequent. The only anchorage in the inner bay is a stretch of reasonably deep water sheltered by a long projection of the reefs, from which rise several small islands; at high tide the reefs moderate, but do not entirely stop, the seas. A vessel caught behind the Nordykes by bad weather has to stay out the storm, because the passage to deep water is long, shallow, and poorly charted. Nevertheless, a cannery tender from Seldovia lay behind the Nordykes occasionally while we were there, to take fish from a few small craft operating from McNeil Cove. The cove has a protecting bar but goes dry at low tide.

At the time of our flight snow was almost gone from the flood plains and lower terraces at the head of Kamishak Bay and along the Kamishak River and its tributaries, though very little green was showing. The valley was about a week behind the Homer area because of the heavier snow cover. We were surprised to find cottonwoods of considerable size on the Kamishak bottoms. Timber and brush were fairly dense on the lower slopes in places, though elsewhere the vegetation was open and savannalike. Broad areas were in grass, both on the bottoms and on the slopes; such areas would be immediately available for pioneer agriculture.

On this first reconnaissance flight we were especially concerned about routes (we found later that we had underestimated the difficulty of boat

[3] See Gerald Seligman's classification of types of snow and ice in "Snow Structure and Ski Fields," London, 1936.

work on the rivers). Shallow water on the flood plain marked muskeg and, as later experience showed, beaver-flooded grassland. Grasslands in general promised better going than they furnished. Not only did they produce a cover of almost African height and density, but the dead grass of past seasons was matted deeply over the surface of the Katmai ash, requiring more feet than ours to beat it down to a firm path. In places the bears helped, but bear trails unfortunately did not lead consistently toward our objectives; moreover, the tracks of large Kodiak bears are inconveniently spaced 10 inches or a foot apart laterally.

The snow remaining on the highlands emphasized the hollows of the ground. Such irregularities were minor; the broadly curving outlines of the valleys and ridges were as expressive of a deep ice cover as the cirques and towers of the Alpine Group, from which the icecap seems to have radiated. Nivation had hollowed out each major joint or weak stratum in the sedimentary rocks of the hills, so that their geologic pattern was outlined in snow. Between the open ridges and the forest and savanna of the lower slopes was an almost continuous band of dense snow-alder brush, which extended down to sea level wherever the forest could not maintain itself against wind or snow. This was the case along most of the shore of the outer bay; in fact, the slopes 10 miles north of the mouth of the Kamishak could not even maintain alder, and there the alpine tundra of the upper ridges descended to the sea. In the valley the upper limit of alder seemed to be about 2000 feet. The upper limit of savanna was much more irregular, reaching perhaps 1500 feet in places.

Establishment of Camps

We had intended to establish a base camp on the Big Kamishak as our first step, but unsuitable weather for transportation of supplies caused us to change our plans and make our first camp in Amakdedulia Cove, directly behind the Nordykes. Here tundra comes down to the beach, though on near-by slopes alder goes uphill about a thousand feet wherever it finds shelter. Though we set up our camp in the narrow, curving valley of an intrenched creek, we were subjected to more or less constant winds. Wind stripping of the turf along sea-cliff edges and on exposed ridges supported the evidence given by the vegetation of heavy, persistent winds. At McNeil Cove, our next move, the weather remained almost continuously bad. Grasslands and brush were soaking wet all the time, and the fishermen at the cove found few chances to get beyond the bar.

A couple of good days enabled us to establish our main camp on the

Big Kamishak River. The run from the anchorage to the mouth of the Kamishak is 12 miles of shallow water filled with uncharted reefs. We made the run many times that summer in boats with 22-horsepower outboard motors, usually in pairs in case of breakdown. No matter how carefully we shaped our course, we frequently ran aground. During the summer we wore out half a dozen propellers and used up some dozens of shear pins. Settlers in the area might navigate the river more freely with tunnel-stern or sternwheel craft.

On each side of the shallow channel mud flats, emerging among the reefs, slope very gradually up to beach ridges that mark the upper limit of normal wave action. At low tide the flats are exposed for a mile or even two miles. On the right side of the channel a small island, sharply cliffed but with a gently rolling summit, stands as a remnant above the reefs. Its summit level is approximately the same as that of other islands, forelands, small plateaus, and terraces scattered around the bay and up the valley. I will use for it a term originated by our chief and call it the "Nordyke surface."

The Nordyke and Other Surfaces

The Nordyke surface is a marine-erosion surface that was once continuous with old valley floors throughout the Kamishak Bay–Cape Douglas area. Marine erosion in the Kamishak Bay area since the Pleistocene seems to have begun at the Nordyke level and to have been renewed later at a level slightly above the present sea level. The present reefs were formed at the time of the second level. With respect to similar but much narrower reefs in the western Aleutian Islands, a geologist friend contends that the cutting of terraces at such a level was due entirely to the assumed maximum effectiveness of wave action at high tide. The Kamishak reefs argue against such a hypothesis, because they are so extensive and level. Quantities of detritus could not have been carried across such a broad level surface without leaving some deposits, which could have been removed only after elevation of the shore.

Remnants of the Nordyke surface, identical in origin and form with the Nordykes and the small island on the reefs described above, lie in the flood plain west of the channel. As we proceeded upstream looking for a campsite, the banks gradually rose from bare mud flats to sedge meadows, to grasslands obviously flooded by fresh water during high tide, and then to grasslands that could be flooded only seasonally, if at all. All the bottomland seemed to possess agricultural possibilities, but not all of it turned out to be as good as it looked, because the poorly drained parts of the higher flood-plain terraces were occupied by muskeg.

The "islands" of the Nordyke surface west of the channel gave us our first close look at the savanna-type vegetation. It is grassland with some alder and willow brush and gnarled birch trees. The soil of the savanna areas is the undisturbed Katmai tuff.[4]

On the right side of the valley, about a mile from the river, rises the Kamishak-Douglas plateau escarpment, cut at regular intervals by a succession of sharp postglacial canyons, many of them 2000 feet deep. The canyons are essentially V-shaped, though the streams in them are often broadly braided as a result of the volume of debris carried. Their courses are marked by abrupt changes of direction and interlocking spurs. Their headwaters have a definite dendritic drainage pattern near the plateau divide. No cirques exist except those that, to judge by their size and location, were produced by nivation. One cannot avoid being impressed by the work done in the limy, flat-lying sediments of the area by both marine and fluvial erosion since the glaciation.[5] The plateau upland, its general contours still as they were left by the ice, is now dissected into relatively narrow ridges. Where the streams issue from the gorges onto the valley floor, they are building alluvial fans. The alluvium contains a good deal of gravelly detritus, in contrast with that of the flood plain, which is reworked Katmai ash. Lime in the gravels may contribute to the richness of the soils. The best cottonwood timber grows on the fans—tall, straight, close-set trees, many of them more than 150 feet high.

The Base Camp Established

On the reconnaissance flight we had spotted an old trapper's cabin some distance upstream from the river mouth. It proved to be poorly sited and too dilapidated for use, but we unloaded the boats there and let them get out of the river on the same tide. Two of us stayed to keep bears out of the food. We saw none that night, though the bear problem was to be with us all summer. We did have some mosquitoes—a nuisance we had not been troubled with in the windier camps on the bay. However, mosquitoes never

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[4] The National Geographic Society's expeditions to the Katmai area have been described in the *National Geographic Magazine* and technical papers. See G. C. Martin: The Recent Eruption of Katmai Volcano in Alaska, *Natl. Geogr. Mag.*, Vol. 24, 1913, pp. 131–181, and several articles by R. F. Griggs: "The Valley of Ten Thousand Smokes: National Geographic Society Explorations in the Katmai District of Alaska," *ibid.*, Vol. 31, 1917, pp. 13–68; "The Valley of Ten Thousand Smokes: An Account of the Discovery and Exploration of the Most Wonderful Volcanic Region in the World," *ibid.*, Vol. 33, 1918, pp. 115–169; "Our Greatest National Monument: The National Geographic Society Completes Its Explorations in the Valley of Ten Thousand Smokes," *ibid.*, Vol. 40, 1921, pp. 219–292.

[5] Dr. Joseph E. Williams' recent article on "Chemical Weathering at Low Temperatures" is suggestive in this connection, particularly his ideas about the concentration of CO_2 in deep thawing snow (*Geogr. Rev.*, Vol. 39, 1949, pp. 129–135).

got so bad in the valley that we were forced to wear nets, and after mid-July they bothered us only intermittently. Next morning the boats came in with another load and picked us up, and we moved to a campsite downstream.

The new site was on the east side of the river, on the outside of a wide meander, where a large creek emerged from its canyon and crossed an alluvial fan to the river. The creek supplied water somewhat clearer, usually, than the river water. Willows and cottonwoods afforded shelter and firewood—and also cover for bears. Float planes could land in any of several reaches of the river within a mile or so, at mid-tide or higher. The tents were pitched on a slight rise about 200 yards from the bank. The high Cook Inlet tides rose among the grasses and sedges of the intervening ground, flooding into little creeks, and later in the season lapping at the tent pegs. Low tides often uncovered half of the river bed and left muddy banks about eight feet high.

The better part of a month had now passed. The Kamishak bottoms, brown and leafless in May, had been rushing through the rapid springtime characteristic of these latitudes. Moreover, we had taken a long step into summer simply by moving into the Kamishak Valley proper. For several weeks the sun shone almost every day. We often had typical foehn conditions: rain clouds sweeping down off the plateau scarp would reach camp with only a few drops of rain, while to the north over the bay we could see hurrying clouds, almost always trailing heavy veils of rain. We had to push through our work in the lowlands, because the landscape in which a bear had been visible for a dozen yards even through the denser thickets was reaching a condition in which a small brownie could take cover by lying down, even in the more sparsely grassed places, and alder and willow thickets were getting so dense that a rifle would soon cease to be much protection.

The volume of mud carried by the Kamishak and other rivers entering the bay is so great that clams and other marine organisms do not mature well, though we saw large numbers of tiny clams and a heavy set of young barnacles. Neither was there much fish life. There were some seals on the outer reefs—very bold and curious and probably taking the pink salmon that later appeared in the streams. Up to the time we left, the salmon run seemed scant, probably because silt derived from the Katmai ash blankets most of the spawning areas. There would be enough pink salmon for domestic use by settlers, but hardly enough, so far as we could tell, to support a commercial fishery. The sockeye salmon taken by the fishermen at McNeil Cove

require a lake within reach of their spawning migration and consequently do not enter the Kamishak and its tributaries.

The Valley

The mud flats and salt marshes around the mouth of the river would not be of much immediate use to settlers without extensive diking. At present the inner edge of the flats is marked by low beach ridges of gravel, with windrows of driftwood. Matted vegetation forms a muskeg, in part salt marsh, between the beach ridges and the pre-Katmai sea cliffs cut in the foot of the hills and birch "islands" that rise behind it. Against the old sea cliffs lies old rotted driftwood, probably cast up after the eruption but before the beach ridges were as large as they are now.

Along the riverbanks the flood plain proper begins as soon as wave action becomes slight enough to permit sedge to establish itself. East of the channel the sedge meadows are broad, extending almost a mile inland to the neighborhood of our base camp, where there is a transition to grassland. Up to that point, alluvial soil derived from the Katmai ash is accumulating so fast that each year's mat of dead grass is buried by fresh alluvium. Grass probably occupies all the ground that is flooded only by fresh water backed up by the tide; the sedge meadows occasionally get salt water driven over them by storms.

Upriver bottomlands are flooded only seasonally, if at all. The tide scours the channel for five miles up the valley from the river mouth. The channel above our base camp seems to have been choked by ash-derived alluvium for some time after the eruption of Katmai, so that the flood plain was heavily aggraded. Tidal scour was effective, however, and most of the small creeks rapidly became intrenched as the river regraded itself. The areas covered with considerable alluvial fill have fairly good drainage; hence grass extends some distance from the banks of the intrenched streams before giving way to muskeg. Older terraces protected by rock outcrops probably date from the period of reef planation; they lie at almost the same level as the ash fill. On such terraces muskeg, well established before the Katmai eruption, simply resumed growth over the tuff. In several places beavers had flooded the upriver grasslands and were apparently living entirely on grass, though willows were abundant close by.

In the cottonwood timber, glades may be of scrub-willow brush or of grass; snow alder alternates with both as undergrowth in deeply shaded spots. On much of the grassland quantities of dead limbs are still buried in the matted old growth, as though brush had recently occupied the ground.

The same thing can be observed in the savannas, which seem to be the result of the failure of brush to maintain itself completely after the Katmai eruption on slopes and rolling land originally in scrub willow, birch, and alder. The grass has been unable to crowd out the birch.

Agricultural Land

Only experience can show whether the alluvial fans now in cottonwood, the better-drained bottoms, or the rolling or moderately sloping savannas would make the best agricultural land. The cottonwood fans would require laborious clearing; the open ground, which would need only careful preburning, would be more readily available to the settler. On the other hand, the fans have excellent natural drainage without being irregular, and the limy detritus mixed with ash alluvium in the soils may give them added value.

Study of the problem of preburning the grasslands would be worth while. The matted old musty grass among the roots of the new growth is often 10 inches deep. Only the surface would burn except in very dry weather, and then burning would be difficult to control. It could be burnt best, I suppose, just after the snow melted, with drying periods between burnings. Burning might be effective in clearing scrub willow, too. Grassland on the bottoms is limited because of the muskeg, but savanna spreads widely into the western tributaries of the Kamishak.

Muskeg presents a problem not yet satisfactorily solved. It occurs when a heavy accumulation of organic material holds the chill of winter so late, and becomes so acid, that nothing but bog plants can live; in the Kamishak area it does not yet occur except on ground that would be poorly drained in any case. The difficulty is that the peat does not dry out enough to decay even when the subsoil is well drained. The only solution would be to remove or destroy the peat completely, perhaps by fire in one of the periods of very dry weather that sometimes occur in summer; and, again, it must be emphasized that risk of forest fire would be great.

An Accident and Further Adventures

Exploration of the valley areas described above took up most of the first weeks after the main base camp was established. Our next venture outside the valley proper was up the Little Kamishak. We set up a camp at the head of navigation on Strike Creek, an equal tributary of the Little Kamishak. An accident at the camp coincided with the first heavy storm of the season in the valley proper. We returned the patient to the base and set about getting word out for a plane. Our radios were Forest Service sets with a

limited range, but we were fortunate enough to get through to the party digging pumice on Augustine Island. They relayed the message to stronger stations, which succeeded in reaching the Tenth Rescue Squadron, an Air Force outfit that answers such calls as part of their training routine. The squadron made two remarkable flights. The first attempt was turned back by thick weather down to the water just outside the bay. When reports relayed from the valley continued to speak of clear air over the landing area, another attempt was made, and this was successful. During the whole storm there was several hundred feet of ceiling over the lower valley; in fact, throughout the summer the time of zero ceiling over the valley could have been counted in hours. The episode was an expression both of the isolation of the valley and of its climatic advantages over adjacent areas.

From an advance camp on a bar of the upper Little Kamishak, beyond the birch savannas, we pushed our explorations as far as the divide looking into the middle McNeil Valley. Dense snow alder and coarse rain-wet grass, now reaching its impressive full height and thickness, made movement difficult. The mosquito season was at its climax. We almost lost the camp when the river suddenly rose over the bar after a heavy rain. That storm, like the previous one, seemed to be caused by warm Pacific winds from the southeast rounding Cape Douglas and rising over the mountain front.

In the meantime other parties were exploring the lower reaches of Strike Creek and the ridge between it and the Little Kamishak. Both are sizable streams flowing through deep postglacial gorges. Both have large waterfalls that could furnish power in quantity. The falls of Strike Creek, at the head of outboard navigation, are the more accessible. They are about 35 feet high, and rather impressive. Just west of the falls a small stream drops 150 feet into a narrow cut in the sedimentary strata. Lower levels of the country around the falls are in birch savanna, upper levels in snow alder. There are some deeply grassed meadows in hollows etched by nivation wherever a stratum was not as resistant as its neighbors or along the large joints that traverse the formations; such meadows, conveniently linear in pattern, relieved us of the necessity of cutting miles of trail. Above the alder is a broad ridge covered with alpine tundra of the type common in the Aleutians at the same levels. Lag gravels on the ridgetop are covered with Katmai tuff, which has been blown or washed off only locally, so that the tundra is more extensive than it was before the eruption. The Kamchatka rhododendron, a pretty pink dwarf form, was especially abundant on the upland tundra around the Kamishak Valley.

After the work from the Strike Creek camp was completed several days

were put in on the reefs and along the base of the sea cliffs on the east shore of the bay toward the Douglas River, and a camp was pitched at the mouth of that river, though no exploration of its shifting, shallow course was attempted. One of the most interesting discoveries made by the Douglas River party was a stunted spruce on a hilltop close to the river mouth. It was the only spruce we saw in the watersheds of the Kamishak and Douglas, and I doubt whether there are any in the McNeil either. We eventually did considerable flying and also covered the most favorable parts of the Kamishak on foot. There may be some spruce in the narrow valley heads of those watersheds adjacent to the Savonoski watershed, but we saw none.

The Unabashed and Curious Bear

Bears were seen fairly frequently all summer. One encounter came while we were cutting a trail to the upper reaches of the Big Kamishak through dense undergrowth in the cottonwood timber. Fortunately, the bear charged while we were taking our dinghy through a shallow slough; with equal determination in the brush he might have got one of us. He was big, about a thousand pounds, and very fast. Any pioneer settler in this area will have to live with his rifle as we did, for several seasons at least. Bears are appealing animals, but they are too intelligent to be predictable, and altogether too large and dangerous for intimacy. Established trails seem to arouse their curiosity, and besides that they apparently find them convenient. We actually felt safer while breaking new trail, because the bears would be less able to guess our movements.

During the last few weeks of July we put out two camps by air, one on the shore of a beautiful unmapped lake on the peninsular divide in the Alpine Group, the other on the shore of Iliuk Arm of Naknek Lake. The former lake is important chiefly because it is about three miles long—more than enough for most float planes or seaplanes. Pilots should look it over carefully first, because part of it is shallow, with boulders close to the surface, but they are easily seen and do not interfere with landing on the main body of water. The lake lies between the Little Kamishak Valley and the Kulik Lake drainage basin on a pass about 1400 feet high, the best available to anyone traveling on foot or by light plane between the Kamishak and the Iliamna-Naknek area. Our Norseman used it regularly. The granite and granitized-conglomerate mountains around the lake rise steeply to remarkably sharp ridges with rock pinnacles (gendarmes); they contain many hanging glaciers. The Alpine Group would be a fine spot for recreational mountaineering. Except for its isolation, it might well become a tourist

center comparable with the Dolomites or Grand Teton. Alaska has many mountains, but most of the really interesting ones require organized expeditions.

The Naknek Lake area is fairly well known and traveled, but its interest for us lay in its vegetation, which we wished to compare with that of the Kamishak area as a measure of climate. Naknek Lake has spruce, and a heavy stand of spruce extends up the Savonoski River. The spruce does not seem to have suffered from the Katmai eruption except where it has been deeply buried by the aggradation of the Savonoski which followed the eruption. If spruce had existed in the Kamishak Bay watersheds before the eruption, the dead snags could still be found, but in any case it would be unreasonable to suppose that the eruption would kill spruce there and leave it unharmed on the Savonoski.

Distribution of Snow

The most apparent difference between the climate of the Kamishak and that of near-by areas with spruce is the weight of winter snow. The Naknek-Savonoski basin opens on Bristol Bay, which is frozen in winter and consequently acts climatically as a continental area. Pacific air masses are kept out of the Naknek watershed by the Aleutian Range to the south. Vegetation on the south shore of Iliuk Arm is what one would expect where winters are cold and dry. Brush is concentrated in the gullies on the mountainsides, instead of being swept out by avalanches, as on similar slopes in the Kamishak watershed. In the coastal mountains from the Columbia River north the species of alder that grows in areas having heavy snow has a characteristic downhill bow in order to lie flat on the ground when masses of wet snow begin to creep or slide over it and to spring up again when the snow melts. This was true of alders in the Kamishak, but the alders behind our camp on Iliuk Arm stood straighter than I have ever seen the species stand, though they retained a bit of the usual downhill bow at the base. So far as I know, spruce timber of the kind in the Kenai and Alaska Peninsula areas closest to the Kamishak is not found in areas that have extremely heavy thawing snow. This is probably why it is excluded from the Kamishak watersheds.

Lack of spruce will be a handicap to settlement in the Kamishak, because the birches are too gnarled for use in construction, and the cottonwoods are too weak and nondurable. Planted timber of species able to survive the snows would undoubtedly do well, but it would not reach useful size for many years.

Game, another factor in pioneer economy, is not especially abundant in the Kamishak. Bears are more numerous than one would wish, but not as

much so as their unabashed appearances would indicate. Also, they do not seem to be as large as the bears on Kodiak Island and consequently would not attract as many guide fees. Beaver are abundant. We saw a dozen moose or so, and there were obviously more in the higher lakes, but in no surprising numbers. Damage to willow stands on the banks of the Big Kamishak has been so extensive over a long period of years as to suggest that moose too suffer from excessive winter snow.

Heavy winter snow does not necessarily mean extreme winter cold. Rather, one would expect winters almost as mild and moist as those of Southeastern Alaska. The opposite side of the climatic coin is the long mild to warm summer. The frost-free season may begin before the snow has entirely melted; at any rate, we had no frost while we were there, though we arrived only a short time after the last snow had gone from the bottomlands. How late the growing season would last into autumn we had no way of learning.[6]

In the latter half of July we spent many fine days in base camp, waiting for the Norseman to come over from Naknek. During that time the pink salmon began to run, and we had several visits from bears feeding on them. The Norseman had a great deal of trouble in getting out of Naknek, on the coast of foggy Bristol Bay, on days when the weather was excellent on our side. In early August, after completing the series of flights, we put the finishing touches on our ground work and left the area.

Prospects for Settlement

The factor of isolation has been mentioned several times in connection with the activities of our party. Under present circumstances a settler in the Kamishak Valley would be extremely isolated. He could maintain contact with the outside world by radio. Float planes or ski-equipped planes could reach him fairly promptly in good weather. He could keep a small boat, but not one that could cross Cook Inlet in winter. Even such meager contacts would require a cash income derived from a salable product that would have to be compact and easily handled—furs, for instance, though they could be taken as easily by transients. Agricultural products would not suit.

The most pressing reason for contact with the outside world is the need for medical care. In comparing the settlement of Alaska with that of the

[6] O. E. Baker gives the frost-free period in the Matanuska as 130 days (Agricultural Regions of North America, Part IX—The North Pacific Hay and Pasture Region, *Econ. Geogr.*, Vol. 7, 1931, pp. 109–153; reference on p. 116). The Kamishak, lying much farther south and with more effective marine control, should have a frost-free season considerably longer than that. See also W. A. Rockie: A Picture of Matanuska, *Geogr. Rev.*, Vol. 32, 1942, pp. 353–371; reference on climate on pp. 354–358.

continental United States, one should remember that people going out to the earlier frontiers left behind no such medical resources as are now available in settled places. Education is another problem that is more critical on the frontier today than it was a century ago, simply because standards are higher. The cost of education is already a heavy burden on the Territory. Higher education in particular often involves sending money to support a student away from home, another reason why the settler must be assured of a cash income.

In addition, the settler in the Kamishak would require many devices for his comfort, or to save labor, that are unavailable to anyone lacking a cash income. To go back to the frontier techniques of a century ago would be physically possible, but certainly unprofitable. No one with access to the opportunities available to a United States citizen today would be wise to settle in the Kamishak Valley as it is now, except for the adventure. To settle any large group of noncitizens in the Territory at present would be impolitic because of its strategic importance.

An Airfield Site

These remarks may seem to shut the door on settlement in the Kamishak, but they are true. There is one real possibility of improving conditions for settlement. The Kamishak Valley looks like an exceedingly good site for an airfield, because of its geographic position in relation to Anchorage, the towns of the Kenai, and Kodiak, and to the airways from those places to Bristol Bay and the Aleutians. The valley has not been considered for that purpose till now because no one was acquainted with the climatic advantages it seems, from our experience, to have. Another reason is that it is difficult to approach by sea. This obstacle could best be overcome by lightering equipment and supplies from the Nordykes into McNeil Cove and building a road into the valley from there. Another possibility would be to use a shallow-draft river boat between the Nordykes and points on the river, with McNeil as a refuge in case of need.

Such a development would change the economic situation considerably. Freight planes large enough to be reasonably economical could be chartered to carry products, especially if they were returning light from the Aleutian chain. Personal travel would be simple. The maintenance personnel would buy local products. Assurance of a minimum population would lead to improvement of charts and pilot data on the bay.

All this is speculation, of course, but so is any statement about the future of Alaska, especially as regards settlement in places now unoccupied.

RECENT GEOGRAPHICAL RESEARCH IN ARAGON*

ALICE FOSTER AND ROBERT AITKEN

ARAGON, a traditional division of Spain, has had no official status for a century, but in the thinking of the people it still ranks as a regional unit. Geographical research there is under the leadership of José Manual Casas Torres, a young professor at the University of Zaragoza. It forms part of a comprehensive program sponsored by the national government and organized under the Consejo Superior de Investigaciones Científicas, with branches for the various fields of learning. One branch, for example, is the Instituto "Balmes" de Sociología; another, the Instituto "José de Acosta," engages in geological research; and geographical investigation is the responsibility of the Instituto "Juan Sebastían Elcano." The Instituto "Juan Sebastían Elcano" was founded in 1940. Its official organ, *Estudios Geográficos,* published quarterly, is the source for much of this discussion (see Appendix).

LAND AND PEOPLE BY ALICE FOSTER

Aragon consists of the three present-day provinces of Zaragoza, Huesca, and Teruel. It occupies a north-south belt of country 75 to 100 miles wide that stretches across the trough-like basin of the Middle Ebro from the crest of the Pyrenees to and beyond the southern margin of the basin to include the major stream divide of the Iberian Peninsula at the eastern edge of the Meseta. The arrangement of valley routes directs the interests of the inhabitants toward the Ebro Valley from both north and south, focusing them principally on Zaragoza. This rail and highway center on the Ebro lies at a convergence of routes—from Catalonian industrial cities, from the Valencian lowland, from the principal cities of Old and New Castile, from Pyrenean passes on the French border, and from the Bay of Biscay coast.

Landforms

The Ebro flows through a partly filled structural basin rimmed by the Pyrenees, the Cordillera Ibérica on the northeastern margin of the Meseta, and the Catalonian Mountains on the Mediterranean coast. The river follows a meandering course along the axis of the depression and escapes to the Mediterranean through a gorge. The northern rim of the basin is much the higher: the Aragonese Pyrenees contain 15 peaks that rise above 10,000 feet; the higher peaks of the Cordillera Ibérica do not reach 8000 feet. The irrigated alluvial plain of the Middle Ebro, the most densely peopled part of Aragon, has a maximum width of six miles in the vicinity of Zaragoza, and belts of irrigated alluvium extend up the tributary valleys on both sides. On the north the Ebro valley wall rises some 300 feet above the flood plain to a belt of hills clothed with xerophytic woodland. Beyond the hills the level to rolling

*The two contributions combined in this review article were received independently.

➤ MISS FOSTER, who is engaged in research and writing at the University of Chicago, has been interested in the geography of Spain for some 25 years. Her article on the Málaga Raisin District has been translated into Spanish by Dr. Casas Torres for publication in *Estudios Geográficos.*

MR. AITKEN, formerly in the British Civil Service, read geography at Oxford with Herbertson. He has an intimate knowledge of Spain, acquired in the 25 years preceding the civil war.

FIG. 1

Somontano, famous for its fertility, extends to the foothills of the Pyrenees. This cereal and vineyard area contains the provincial capital of Huesca. On the south the Ebro valley wall has a gentler slope, but the foothills of the Cordillera Ibérica reach within a few miles of the alluvial plain. Teruel, the capital of the southernmost Aragonese province, lies in a valley of these mountains.

The Ebro depression resulted from the diastrophic movements that, early in the Cenozoic era, lifted the basin rim and enclosed a vast body of sea water. Before the end of the succeeding arid period the enclosed sea had shrunk to a series of salt lakes, in which gypsum deposits were laid down with associated beds of salt and of magnesian and potash minerals. Uplift continued intermittently, at least into the Miocene. Changes of level are recorded in the interrupted gradients of Pyrenean valleys and in the varying texture of the deposits. Humid and arid conditions alternated. In the Pliocene an outlet to the Mediterranean was established, and the Ebro began cutting its gorge across the Catalonian barrier. Since that time the base level of the Ebro has been lowered some 800 feet, and active erosion of the basin sediments has left fragments of the earlier level as flat-topped hills capped with limestone. Later, an elevation of the erosional base level led to extensive sedimentation in the valleys of the Ebro and its major tributaries, a phase that has continued to the present.

Pleistocene glaciation was much less extensive than in the Alps. Serrate divides, cirques, and U-shaped valleys appear in the granitic axial zone of the Pyrenees; but glaciers extended relatively short distances down the valleys, and the Pyrenees contain nothing comparable to the deep longitudinal troughs of the Alps. However, moraines furnish favorable sites for mountain villages; the floors of glacially reshaped valleys offer space for small-scale agriculture; and glacially smoothed uplands are utilized as summer pastures.

Climate and Soils

With the exception of the Pyrenean section, Aragon belongs to "Dry Spain." Semiaridity characterizes the Somontano and the southern rim of the basin; the interior is arid, with aridity reaching a maximum about Zaragoza, which might almost be classified as sub-

desert.[1] In harmony with the scanty rainfall and the interior location of Aragon, temperatures show continental characteristics. Summers are hot, with the maximum temperature generally above 90° F. and in some years above 100° F. Winters generally are not cold enough for frozen soil, but the minimum in most years falls below 25° F. and thus precludes such specialty crops as subtropical fruits.

The most widespread soil types of Aragon belong to the dry calcareous series of Villar's classification,[2] with gypsum in many localities and scattered saline patches. These soils have developed under arid to semiarid conditions and under a cover of xerophytic woodland or the preclimax *monte bajo* of low woody vegetation. Over most of the region the natural soil profile has been modified by cultural practices, grazing, or deforestation. On the north there is a gradual transition to the acid-humic series, developed under the humid climate and the mesophytic forests of the Pyrenees. On the south the dry calcareous soils continue beyond the limits of Aragon, with irregular variations in the mountainous area. The valleys of the Ebro and its tributaries are floored with hydropedic soils developed from alluvial materials under a cover of mesophytic vegetation and modified by irrigation agriculture.

Distribution of Population

On an area of about 18,500 square miles Aragon contains more than a million people. Thus it is about the size of New Hampshire and Vermont together and has an average population density a little higher than that of New Hampshire alone. The people are concentrated in some 1500 agglomerations distributed along stream courses; the distribution of these clusters reflects certain characteristics of the stream pattern. About two-thirds of the people live in communities along the Ebro and for distances of 20 to 25 miles up the valleys of its principal tributaries. In this central belt, where the tributary waters are concentrated in a few main channels (two from the north and half a dozen from the south), the interstream areas are almost without villages and give the impression of being unoccupied, though they contain large tracts of cultivated land. Outside the central belt the stream pattern forms a closer network and population clusters are more widely distributed. The slope of the Pyrenees, with many south-flowing headwater streams carrying the runoff from small and rugged catchment basins, is characterized by small, closely spaced villages or hamlets.[3] In the Cordillera Ibérica, where valley development is on a larger scale, villages are correspondingly larger and more widely spaced. There is a notable concentration along the Jalón, principal southern tributary of the Ebro, and across an inconspicuous divide to Teruel, in the valley of the Turia, which reaches the Mediterranean at Valencia.

Agriculture and Irrigation

As in most sections of Spain, agriculture is the chief means of livelihood. It comprises

[1] Juan Dantín Cereceda and Antonio Revenga Carbonell: Las líneas y las zonas isóxeras de España según los índices termopluviométricos: Avance al estudio de la aridez en España, *Estudios Geográficos*, Vol. 2 (No. 2), 1941, pp. 35–91.

[2] E. H. del Villar: Los suelos de la Península Luso-Ibérica, with English translation (somewhat abridged) by G. W. Robinson, Madrid, 1937.

[3] See the map "Distribución geográfica de la población aragonesa," 1 : 750,000, *Estudios Geográficos*, Vol. 3 (No. 7), 1942, facing p. 336, which illustrates Juan Dantín Cereceda's article "El medio físico aragonés y el reparto de su población" (listed in the Appendix), published in the preceding number of the same periodical.

secano culture (or dry farming), intensive agriculture on irrigated land, and stock raising. Secano culture occupies practically all the arable interstream tracts—about a quarter of the area of Aragon. Irrigated land falls into two types, land having water available for irrigation the year round, and land having water only for supplemental winter irrigation of secano crops. Only the first can be used for intensive agriculture. Stock raising is associated with both secano and irrigated agriculture, and in addition sheep provide a means of utilizing land not suitable for cultivation. Untilled pastoral land amounts to a little more than half the area of Aragon.

On secano land cereals—wheat, barley, oats, and a little rye—are grown; the deep-rooted perennial vine and olive occupy only a fourth as much secano land as cereals.[4] Wheat occupies about two-thirds of the cereal acreage. Aragon generally ranks among the four or five leading wheat-producing regions of Spain, and normally it furnishes a surplus for shipment to other Spanish regions. Because of the scanty rainfall, nearly half the secano cereal land lies fallow each year. In olive-oil production Aragon ranks fourth among the 14 regions of Spain, and in wine production it ranks sixth.

Irrigation has been practiced in Aragon from time immemorial. Additions to irrigation facilities have been made at various times, including the period of the Moorish occupation, which began later and ended earlier in the Ebro basin than in Valencia and Granada. Small systems of Moorish-built canals are still in use in some of the valleys tributary to the Middle Ebro. The Imperial Canal, oldest of the large works, was constructed in the sixteenth century under Charles I of Spain for the extension of navigation on the Ebro above Zaragoza. At present it irrigates some 57,000 acres, besides furnishing the municipal water supply of Zaragoza. The most notable addition to the irrigation facilities in the present century has been the provision of storage; a score of reservoirs are completed, under construction, or projected. Some are the result of private or group initiative; others were built by the national government. Modern improvements have made it possible to furnish year-round irrigation to land formerly provided only with supplemental winter irrigation and to furnish supplemental irrigation to other secano land. Recent additions to the irrigated area amount to some 39,000 acres.

The land having year-round irrigation is devoted to a variety of special crops, notably sugar beets, alfalfa, garden vegetables, and such middle-latitude fruits as peaches, apples, plums, and pears. Aragon ranks first among the sugar-beet regions of Spain, producing nearly a third of the national crop,[5] and it contains about a fifth of the acreage of alfalfa, which has much importance for the livestock industries of the region. The need for winter feeding of cattle is suggested by the fact that the entire alfalfa crop is cured for hay, whereas three-fourths of that grown in other parts of Spain is fed without curing. As elsewhere in Spain, agricultural production has decreased in recent years, owing to the shortage of mineral fertilizers.[6]

Livestock and Transhumance

Interest in livestock raising extends over the entire region, but in the highlands on the northern and southern margins this is the principal means of livelihood. Sheep constitute the

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[4] *Anuario Estadístico de las Producciones Agrícolas, Año 1944*, Ministerio de Agricultura, Servicio de Estadística, Madrid, 1946.

[5] *Ibid.*

[6] J. A. Vergara, personal statement.

chief source of income; wool is sent to the textile mills of Barcelona after the shearing in early July. Small-scale agriculture and small herds of cattle contribute to the sustenance of the pastoral people, and community-owned woodland yields firewood for local use.

Most of the highland villages occupy valley sites at elevations below 4500 feet, where cultivable patches on flood plain, terrace, or glacial moraine and a growing season of five months or more permit agriculture. The arable land near the villages is devoted to food crops, spring and autumn pasture for milch cows, and hay for winter feeding of cattle and draft animals. In a typical Pyrenean valley, potatoes rank first among food crops and provide a surplus for shipment to Huesca and Zaragoza. Rye is the leading cereal, though wheat has been of almost equal importance during the emergency of war and postwar years. Barley and oats occupy smaller acreages, and apples, pears, and garden vegetables are grown for local use. With the exception of rye, crops generally are irrigated. Rye fields lie fallow in alternate years. Meadow and pasture occupy a large part of the arable land near the villages; meadowland is irrigated, fertilized, weeded, and raked, even though it bears only wild grasses. Hay, two cuttings each summer, is stored for winter feeding of cattle and draft animals, which are stabled from November to April.

The practice of transhumance links the livestock interests of the marginal highlands with those of the interior of the Ebro basin. Sheep are more numerous in the highlands than the small productive areas about the villages can feed the year round; in fact, the flocks are in the home locality only during the spring and autumn, when they spend the nights in fallow rye fields and start out at daybreak to graze on slopes at slightly higher elevations. In summer they climb to community-owned high pastures a thousand feet or more above the villages. In winter they journey to the *tierra llana*, the level or rolling lowland areas in the interior of the basin. There they graze, for a fee, on the shrubby *monte bajo* of untilled tracts, on stubble fields, or on fallow land. The Somontano, for example, winters some 80,000 sheep from Pyrenean valleys. In a reciprocal movement, flocks owned in the interior of the basin travel to the highlands for summer grazing, and the fees paid by their owners add to the income of the mountain communities that hold title to the high pastures. The number of sheep in the Pyrenees of Aragon is believed to be decreasing, though no dependable livestock census has been taken. The principal limiting factor is the extent of winter pasture available in the interior of the Ebro basin; additions to irrigation facilities have resulted in the expansion of intensive land use and a decrease in the area available for winter grazing.

Intercourse within and without the Region

Custom and economic organization lead to a good deal of intercourse both within the region and across the regional boundaries. The pattern of summer-grazing rights in the high Pyrenees brings into contact shepherds from valleys in Aragon and from the French slope. Mountain summer resorts attract people from more distant Spanish cities as well as from the cities of Aragon. The construction of hydroelectric stations in the Pyrenees employs outside labor, and stations already in operation supply current to recently established chemical and aluminum plants in the mountain area, to the city of Zaragoza, and to Bilbao.

Considerable local trade is handled on market days, and seasonal fairs attract intraregional trade of somewhat broader scope. Market relations cause much crossing of provincial boundaries; for a few groups of villages the principal market is outside Aragon. Among the Aragonese livestock fairs, held in autumn when the stock are in good flesh after a summer on the high pastures, that of Huesca is the most famous. As a commercial center Zaragoza

dominates the region; its rail facilities tie Aragon into the domestic trade of Spain and give connection with the French transportation system via the valley of the Aragon River and one of the few usable passes in the central Pyrenees.

MARKET ZONES AND A PYRENEAN VALLEY BY ROBERT AITKEN

THE MARKET STUDY

The series of articles on markets and market-defined zones of Aragon published in *Estudios Geográficos* (see Appendix) is an excellent illustration of the geographical work being carried out in Zaragoza. A simple questionnaire was sent to every *municipio* in Aragon asking for the name of the *comarca* to which it was considered to belong and the names of the principal and secondary markets to which its inhabitants resorted. By *comarca* is meant a district with a popular name given in recognition of some distinctive character; it is the French *pays*, but there is no English equivalent. Comarcas are surprisingly elusive. Many, perhaps, are best apprehended by outsiders. They commonly become more and more indefinite from a core of pure "comarcal" quality toward an uncertain perimeter. In Catalonia, where the *comarca natural* had been laid down in the *Bases de Manresa*[7] of 1892 as the proper administrative division of an autonomous region, a similar inquiry carried out in 1931–1932 brought such confusing results that the *comarques* were in the end replaced for this purpose by market zones given comarcal names. Professor Casas Torres has been at pains to improve on the Catalan procedure by broadcasting his questionnaire more widely in each municpio and, more especially, by explaining the term *comarca* by concrete illustrations. For the term is not firmly attached to the concept even among intellectuals. Asso, in his fundamental work "Historia de la economía política de Aragón," published in 1798 (see Appendix), calls such an area *distrito* and *territorio* in the same breath. He does not use the word *comarca* in the present sense at all; he applies it once to the territory (perhaps in the sense of neighboring territory) of a tribe known to Livy, once to villages bordering on salt pans and forming their market zone. The word is unlikely to be deeply rooted in Aragon.

In the provincial maps appended to the Aragon report the comarcas are not named, but anyone familiar with their identity can see that they include with respect to marketing: negative areas (especially in the central "steppe") such as Los Monegros, the Desierto de Calanda, and El Castellar, whether or not they depend on a single outside marketing center; physical units such as the Hoya de Huesca, or partly historical units such as the Campo de Cariñena, with the clear center characteristic of an *hoya* (basin) or of a *campo* (especially when the word does not refer to a mere plain but has somewhat of the flavor of the *pagus* of antiquity); and also a purely historical complex unit, the Cinco Villas, with both a main center and subcenters. Even the Cinco Villas does not come within Dickinson's recent definition of what he regards as the typical *pays:* "an amalgam of . . . distinct types of country, whose people are interdependent by reason of the exchange of goods and ideas through the medium of a central capital town."[8]

The six maps (primary and secondary markets for the three provinces) are on the scale of 1 : 400,000 and on a tan-colored topographic background show in black the market centers

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[7] The first agreed program for action toward Catalan autonomy, drawn up at Manresa by an assembly of delegates representing all Catalan organizations.

[8] R. E. Dickinson: City Region and Regionalism, London, 1947, p. 263. (Reviewed in the *Geogr. Rev.*, Vol. 38, 1948, pp. 339–340.)

and the chief places of the comarca trading with each center. For an outsider the maps raise abstract questions—their somewhat "geometrical" character invites abstract treatment too—of which Casas Torres would perhaps disapprove; for his object has been to build up a complete regional picture slowly, by a scrupulously inductive process. The questions in the mind of the reviewer will be shown by the immediate impressions made on him by the six maps taken as a whole.

The first impression was of the solidity of Aragon as a human region, linked with the predominance and prestige of Zaragoza. Even in the east, where Pau Vila unblushingly claimed parts of Aragon for Catalonia,[9] Barbastro holds its own against Lérida as the principal market of the lower Cinca and of the zone of the Canal de Aragón y Cataluña. The most one can say is that Lérida competes here with Zaragoza as the "city" market, a type whose full influence is brought out only by the maps of secondary markets and by the information given in the tables but not shown on the maps. Alcañiz similarly withstands the attraction of Tortosa and Barcelona. In the southeast, where Moret is said to have been prepared in 1884 to hand over Teruel province to a proposed Valencian region, Teruel city, itself lying on the Mediterranean slope, is able to hold its own against Valencia. On the other fronts the penetration of outside markets is local.

Zaragoza, which appears as a principal market for places as far away as Jaca and Sallent to the north and Tamarite to the east, and as a secondary market for places as far away as Albarracín and Valderrobres to the southeast, is not seriously challenged as the great market city of Aragon, growing in population much more rapidly than the region and housing (1940) 22 per cent of the total population. We are aptly reminded too that Zaragoza is much more than a mere regional capital: it stands on a nodal site comparable in the Iberian Peninsula with at least that of Madrid and of much earlier importance; as headquarters of the Confederación Hidrográfica del Ebro it is the capital of the Ebro; its archdiocese extends beyond the Ebro basin in Navarra and the military and university regions in Soria.

The second impression was how clearly both the natural regions and the major structural and drainage lines stand out on the maps. The basal topography is difficult to make out here, and the reader is advised to keep before him Dantín Cereceda's article "El medio físico aragonés y el reparto de su población," with its altitude tables (see Appendix). In the Pyrenean mountain zone Graus (509 meters), in the Cinca drainage, is comparable as a market with Jaca (818 meters), a much larger town in the west; in the Somontano there is the same relationship between Barbastro and Huesca. For central Aragon in general, but especially for the "steppe," the map of secondary markets works in reverse, bringing small market towns out of the "shadow" of the overmastering capital; the piedmont level (400–600 meters), with Tarazona, Cariñena, and Belchite, is less important on this side, and there is no good piedmont road. Alcañiz, the olive capital of Lower Aragon, probably owes nothing of its importance to its position on a great road to Barcelona. In the Iberic zone, the largest markets are aligned along the central corridor of the mountain system—Daroca, Calamocha, Teruel, but above all, Calatayud, which stands at the junction of the corridor with the Jalón Valley and is the most rapidly growing Aragonese town next to Zaragoza.

The third impression—and here it is only fair to say that these impressions run counter in part to the author's own views, *judicet lector*—was that nothing in this report makes the present division of the region into provinces and *partidos judiciales* appear arbitrary and irra-

[9] Pau Vila: Resum de geografia de Catalunya, 9 vols., Barcelona, 1928–1937.

tional. With few exceptions the head of a partido proves to be, as in Catalonia, the chief marketing center of its district. In the provinces, likewise, the capitals are the chief marketing centers; Huesca might be more accurately described as one of two chief centers, but it grows more steadily than its rival, Barbastro, and is at least as well situated to reconcile the eastern and western divisions of the province.

Finally, mention must be made of the specialized markets, some of which are noted (Casas Torres and Pardo Cajal, p. 491; the saffron market of Calamocha would be another), and a reminder given that an inquiry into primary markets does not bring out the suction exercised by the great Barcelona market, formerly—perhaps still—felt as far off as Galicia.

These articles are illustrated with striking photographs, as is also a more recent monograph in which the method is applied to the province of Navarra.[10]

In the case of Navarra, the scope both of the inquiry and of the discussion of results has been greatly widened. An additional map shows fairs and their radii of attraction; concrete information is given about the nature and provenance of goods and livestock bought and sold in the markets; and the marketing centers are classified more elaborately. In part this classification is on purely Spanish lines. But German and Swiss precedents have been followed in another classification, according to a scale ranging from "comarcal" markets through "regional" and "super-regional" markets to a highest called "national" (unrepresented in Navarra; Zaragoza is the nearest example). This does not seem happy to the reviewer, who prefers to concentrate on the Spanish material, including the interesting historical notes and maps of the physical background, without the overlay of foreign-inspired theory. A careful comparison of the summaries provided for this monograph in four languages will prove instructive. For example, *comarcales, locaux, county,* and *örtliche,* as equivalent terms applied to markets of the lowest order, give food for thought; the German *Menschentypen-Zonen* seems to belong to a different order of ideas from the *human regions* of the three western languages.

The Valley of Tena

El Valle de Tena is the name given to the upper basin of the Gállego River, best known to the outside world for its position on the direct route from Zaragoza to Pau. The valley qualifies doubly as a comarca—as a well-defined physical unit and as a historical personality. Yet its marketing center is external, at Biescas, with Sabiñánigo as a secondary center.

The well-illustrated morphological description shows that the arch of Cretaceous limestones formerly covering the valley is now worn away except on the cuesta and at the summit of Pico Moros (Balaïtous). Granites appear in a rugged northeastern district of scanty vegetation that includes the massif of Panticosa, the highest glacial cirques (2400 to 2700 meters), and great natural storage reservoirs in the glacial lakes (2100 to 2300 meters). Little but the high peneplain (2850 to 3100 meters) was untouched by the glaciers; the terminal moraine of the maximum glaciation comes within five miles of Sabiñánigo. A peneplain (1650 to 1850 meters) belonging to a later cycle is the great pastoral level, with the chief summer folds.

The principal interests of the valley are pastoral; it is still divided for such purposes into three *quiñones*. Forests, which cover about one-eighth of the surface, provide mainly for local needs, though there are hints of possible improvements. Only small parcels of land near the

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[10] José Manuel Casas Torres and Angel Abascal Garayoa: Mercados geográficos y ferias de Navarra (Monografía de la Institución "Príncipe de Viana" y la Estación de Estudios Pirenaicos), *Publ. Estación de Estudios Pirenaicos No. 10* (*Geografía 3*), Zaragoza, 1948.

villages (lowest at 1107 meters, highest at 1305) can be cultivated; these are improved by irrigation where possible, but the average family holding is small, about four hectares including meadows. All the other lands, about 98 per cent of the whole, are communal, subject to dues payable to the state. From the arable land a surprising amount of wheat was harvested under war conditions (1375 quintals in 1944), which gave, with the more usual rye (1187 quintals), a meager sufficiency of bread cereals for the 2217 inhabitants. Potatoes, the only cash crop, were introduced later in the nineteenth century than might have been expected, since they were in Béarn in the second half of the eighteenth and had crossed to Benasque "shortly before" Asso wrote in 1798.

Of the livestock, horned cattle and mules do not leave the valley. Sheep, coarse-wooled and of a local breed, outnumber the cattle by 20 or 30 to 1. All go south to central Aragon for the winter, a short journey by Castilian standards, made chiefly by the stock roads (*cabañeras*) along which the communes provide guides to show route and resting places.

The fundamental social structure of the valley is shown in the organization of the unitary flock (*rebaño*) of about a thousand sheep, which has usually one principal owner (*cabeza de ganadero*), who is responsible for the wages of the head shepherd and his assistant, and a number of part owners (*atajeros*), who have duties while the flock is traveling or pasturing near the village. Irrigators using the same ditch are organized similarly, with a *cabeza de septenario* and atajeros for each division of the irrigating week.

No restrictive ordinances are mentioned for the communal pastures; perhaps they are inoperative at present, when the high cost of winter pasturage for sheep and the limited amount of winter keep that can be cut and stored for the larger stock are sufficient restriction; the number of sheep is in fact decreasing. Although the "retreat from the mountain" that is leaving so much Pyrenean pasturage idle is less serious here than in Canfranc, for example, where there are now no sheep at all and high pastures are leased to one of the Tena quiñones, it has become hard to find men to take charge of the communal herds of cattle and mules, even with the milch cows left behind in the villages.

The population seems to have decreased, after an intermediate rise, to about the 1920 level, and there is no industry to serve as a check; even domestic crafts are not in the tradition of the valley. The little wool spun locally is sent to the weaver at Biescas, and the surplus milk to a factory there. Hydroelectric power, generated in rapidly increasing amounts, is controlled from Sabiñánigo and benefits primarily industries located there. Anthracite from a small mine opened during the recent war goes to Barcelona. The Balneario de Panticosa, the largest baths in the Spanish Pyrenees, with more than a thousand visitors in the two-month summer season, represents industry of a kind, and there are besides great numbers of strangers lodged in the villages.

This monograph, with its beautiful photographs, is heartily recommended to all suffering from *nostalgie des Pyrénées*.

BIBLIOGRAPHICAL APPENDIX

LANDFORMS

Luis García-Sáinz: Las superficies de erosión que preceden a los glaciares cuaternarios del Pirineo Central y sus recíprocas influencias, *Estudios Geográficos*, Vol. 1 (No. 1), 1940, pp. 45-73.

Idem: Las fases epiglaciares del Pirineo español, *ibid.*, Vol. 2 (No. 3), 1941, pp. 209-268.

Idem: Evolución morfológica del valle del Aragón, *ibid.*, Vol. 3 (No. 6), 1942, pp. 5-31.

J. R. Bataller: El terciario inferior de los alrededores de Jaca, *ibid.*, pp. 33-49.

Clemente Sáenz García: Estructura general de la cuenca del Ebro, *ibid.*, Vol. 3 (No. 7), 1942, pp. 249-269.

AREAS AND POPULATION

Juan Dantín Cereceda: El medio físico aragonés y el reparto de su población, *Estudios Geográficos*, Vol. 3 (No. 6), 1942, pp. 51-162. (See the *Geogr. Rev.*, Vol. 34, 1944, p. 331.)

L. Solé Sabarís: La Canal de Berdún, *ibid.*, Vol. 3 (No. 7), 1942, pp. 271-318.

Luis García-Sáinz: Las regiones del Ebro medio y sus zonas de regadío, *ibid.*, Vol. 3 (No. 8), 1942, pp. 469-503. (See the *Geogr. Rev.*, Vol. 34, 1944, p. 331.)

José Manuel Casas Torres and José María Fontboté Musolas: El Valle de Tena: Rasgos fisiográficos y economía regional, *Pirineos*, Vol. 1 (No. 2), Zaragoza, 1945, pp. 37-107. (Published by the Estación de Estudios Pirenaicos of the Consejo Superior de Investigaciones Científicas.)

R. Violant y Simorra: Notas de etnografía pastoril pirenaica: La trashumancia, *ibid.*, Vol. 4 (No. 8), 1948, pp. 271-289.

CLIMATE AND DRAINAGE

Juan Dantín Cereceda: La laguna salada de Gallocanta (Zaragoza), *Estudios Geográficos*, Vol. 2 (No. 3), 1941, pp. 269-301.

V. Masachs Alavedra: Las variaciones estacionales en el derrame fluvial de la vertiente Sur de los Pirineos, *ibid.*, Vol. 3 (No. 7), 1942, pp. 405-422.

Juan Dantín Cereceda: Distribución y extensión del endorreísmo aragonés, *ibid.*, Vol. 3 (No. 8), 1942, pp. 505-595. (See the *Geogr. Rev.*, Vol. 34, 1944, p. 331.)

URBAN AREAS AND HISTORICAL GEOGRAPHY

Manuel de Terán: Calatayud, Daroca y Albarracín, *Estudios Geográficos*, Vol. 3 (No. 6), 1942, pp. 163-202. (See the *Geogr. Rev.*, Vol. 34, 1944, p. 331).

Isidoro Escagüés Javierre: Nuevos datos de geografía histórica sobre las calzadas romanas del norte de la provincia de Zaragoza, *ibid.*, Vol. 5 (No. 16), 1944, pp. 591-606.

José Manuel Casas Torres: Esquema de la geografía urbana de Jaca, *Anales de los Cursos de Verano de la Universidad de Zaragoza, en Jaca, 1946*, Vol. 1, 1947, pp. 1-54.

PRELIMINARY WORK FOR A DETAILED REGIONAL STUDY

José Manuel Casas Torres: Primeros resultados de una encuesta sobre mercados y comarcas naturales de Aragón, *Estudios Geográficos*, Vol. 6 (Nos. 20-21), 1945, pp. 443-459.

José Manuel Casas Torres and Alfredo Floristán Samanes: Un mapa de los mercados de la provincia de Huesca, *ibid.*, pp. 461-487.

José Manuel Casas Torres and Joaquín Pardo Cajal: Un mapa de los mercados de la provincia de Zaragoza, *ibid.*, pp. 489-523.

José Manuel Casas Torres and José Vicente Araus Azlor: Un mapa de los mercados de la provincia de Teruel, *ibid.*, pp. 525-557.

José Manuel Casas Torres and A[lfredo] Floristán Samanes: Bibliografía geográfica de Aragón, *ibid.*, pp. 559-726.

José Manuel Casas Torres: La investigación geográfica y los Institutos de Investigaciones Locales, *in* Reunión de los Centros de Estudio e Investigación Locales y Provinciales, Jaca, 1945, *Publ. Estación de Estudios Pirenaicos No. 2*, Zaragoza, 1946, pp. 140-152.

Ignacio de Asso: Historia de la economía política de Aragón, Zaragoza, 1798, republished, Zaragoza, 1947, with introduction and annotated list of Asso's published works (pp. vii-xxviii) and analytical indexes (pp. 313-484) by José Manuel Casas Torres, [*Publ.*] *Estación de Estudios Pirenaicos* [*No.* 7].

THE SIXTEENTH INTERNATIONAL GEOGRAPHICAL CONGRESS, LISBON, 1949*

JOHN K. WRIGHT

THE Sixteenth International Geographical Congress met in Lisbon, April 8–15, 1949. Except for the formal opening and closing ceremonies, the sessions were held in the fine new buildings of the Instituto Technico Superior, about a mile and a half from the business center of the city and easily reached by the taxis that abound in Lisbon and are operated at fares that seemed remarkably reasonable to the 38 Americans who attended the Congress. Unbroken fair weather prevailed; indeed, several days were marked by an unseasonable heat wave.

The Congress convened for the formal opening in the magnificent parliament hall of the National Assembly. Geographers from 29 countries occupied the chairs of the Portuguese legislators; General Carmona, President of the Republic, Professor Emmanuel de Martonne, President of the International Geographical Union, and Dr. Pires de Lima, Minister of Education, sat on the high speaker's rostrum. On behalf of the Government of Portugal, Dr. Pires de Lima welcomed the Congress (in French) and spoke of the achievements of Portuguese explorers and geographers. Addresses were delivered by Professor de Martonne and by Professors George B. Cressey (Syracuse University, U.S.A.) and W. E. Boerman (Netherlands), members of the Executive Committee of the Union. Professor Cressey stressed the importance of geography's potential contributions to an understanding of contemporary problems and to the securing of peace.

The meetings of the Sections, for which seven periods of two or three hours each had been reserved on the program, began on Saturday morning. Two general assemblies of the Congress were also held; at the first, on Saturday afternoon, the President outlined the program, and the Secretary, Mlle M. A. Lefèvre, presented a full report on the work of the Union since the Fifteenth Congress, held in Amsterdam in 1938. The formal closing session of the Congress took place in the great flag-decorated museum of the Lisbon Geographical Society, with the speakers' table appropriately overlooked by a monumental painting of Vasco da Gama. Professor de Martonne voiced the thanks of the Congress for the hospitality that had been extended by the Portuguese government and local authorities and paid tribute to Professor Orlando Ribeiro, who had borne most of the burden of organization and management. In a gracious reply, Professor Ribeiro spoke of his debt and that of geography to Professor de Martonne, "dean of the geographers of the world." A brief address of thanks and appreciation was also made by Professor Cressey, the incoming President.

In expressing appreciation of the hospitality with which the Congress had been received, Professors de Martonne and Cressey were far from performing a perfunctory task demanded by international courtesy. No one who had the privilege of attending the meetings could have failed to be impressed not only by the lavish scale on which the Congress was entertained

* Grateful acknowledgment is made to the following for help in the preparation of this report: Roberto Almagiá, S. W. Boggs, G. B. Cressey, Alice Garnett, Henri Gaussen, Arthur Geddes, David L. Linton, Charles Robequain, and L. Dudley Stamp.

See also S. W. Boggs: The Sixteenth International Geographical Congress, *Scientific Monthly*, July, 1949.

but also by the genuine warmth and cordiality with which its members were everywhere received by individual Portuguese. Formal receptions for all members were held by the Minister of Education in the halls and gardens of the elegant Aviz Hotel, by the President of the Municipal Council of Lisbon in the "Estufa Fria," a great lattice-covered garden of tropical plants, and by the National Bureau of Information at the Museum of Popular Art at Belem. A sumptuous banquet was given for the heads of delegations and officers of the Congress by Dr. Gustavo Cordeiro Ramos, President of the Instituto Technico Superior. Particularly memorable was the "Gala Evening," in the National Theater of San Carlos (opera house); a superb *schola cantorum* rendered a selection of Portuguese choral music, and the National Symphony Orchestra played a symphony by a young Portuguese composer and the finale of De Freitas Branco's "Première suite alentejana."

General Assembly and Commissions

At the second general assembly, held on the last day of the Congress, China, India, Hungary, and Turkey were admitted to membership in the International Geographical Union; an invitation to hold the next Congress in the United States in 1952, extended by the National Research Council and supported by the Association of American Geographers, the former American Society for Professional Geographers, the American Geographical Society, the National Council of Geography Teachers, and the Geographic Society of Chicago, was accepted; and the following officers were elected: Honorary President, Emmanuel de Martonne (France); President, George B. Cressey (U.S.A.); First Vice-president, Marguerite A. Lefèvre (Belgium); Vice-presidents, Roberto Almagiá (Italy), Hans Boesch (Switzerland), George H. Kuriyan (India), Christovam Leite de Castro (Brazil), Orlando Ribeiro (Portugal), L. Dudley Stamp (England); Secretary-Treasurer, G. H. T. Kimble (Canada).

In the intervals between the Congresses the scientific work of the Union is carried forward by commissions. Upon the recommendation of the Executive Committee, the following commissions (chairman in parentheses) were continued: Study of Population (C. B. Fawcett, Great Britain), Study of Industrial Ports (W. E. Boerman, Netherlands), Agricultural Geography (Daniel Faucher, France), and Bibliography of Ancient Maps (Roberto Almagiá). Upon a plea by Henri Baulig (France), supported by the President, the Commission of Pliocene and Pleistocene Terraces (Henri Baulig) and the Commission on the Cartography of Tertiary Surfaces of Denudation (Emmanuel de Martonne) were also continued. The Commission on Aerial Photography was reorganized as a Commission on the Utilization of Aerial Photographs (M. Barrère, France), and six wholly new commissions were established: Geographical Research regarding Regional Planning (Jean Gottmann, France), Periglacial Morphology (H. W. Ahlmann, Sweden, International Map of the World, 1: 1,000,000 (John K. Wright, U. S. A.),Study of the Problems of Medical Geography (Jacques M. May, U.S.A.), World Inventory of Land Use (Samuel Van Valkenburg, U.S.A.), and Soil Erosion (Edward Ackerman, U.S.A.).

Registration and Attendance and Communications

The total registration for the Congress numbered 706 individuals and institutions. Some 330 persons, including 140 Portuguese, attended. The countries having the largest representations were Portugal, France, the United States, Great Britain, Italy, Spain, Switzerland, and

Brazil. Argentina, Austria, Belgium, Canada, Ceylon, China, Colombia, Cuba, Denmark, Egypt, Finland, Greece, Netherlands, Norway, Peru, Sweden, Turkey, Uruguay, the Vatican, and Venezuela were also represented. Geographers from the U.S.S.R., Czechoslovakia, and other countries behind the "iron curtain" did not participate in the sessions, though Poland was unofficially represented by a Polish resident in Great Britain.

Meetings of the Sections

The Sections of the Congress, their officers, and the approximate number of communications submitted to each were as follows:

Section I, *Cartography*. President: John K. Wright (U.S.A.). Vice-president: Eugene Romer (Poland; absent). Secretary: B. W. Adkinson (U.S.A.). 48 communications.

Section II, *Physical Geography*. Presidents: Alan G. Ogilvie (Great Britain) and Niels Nielsen (Denmark). Vice-presidents: F. Hernández-Pacheco (Spain) and P. Birot (France). Secretary: David L. Linton (Great Britain). 56 communications.

Section III, *Biogeography*. President: Henri Gaussen (France). Vice-president: P. Dansereau (Canada; absent). Secretary: D. Duarte de Castro (Portugal). 11 communications (one presented at a joint meeting with Section I).

Section IV, *Human and Economic Geography*. Presidents: L. Dudley Stamp (Great Britain) and Maximilien Sorre (France). Vice-presidents: O. Tulippe (Belgium) and Amorim Girão (Portugal). Secretary: Jorge Zarur (Brazil; absent). 50 communications.

Section V, *Geography of Colonization*. President: Charles Robequain (France). Vice-president: J. J. Hanrath (Netherlands). Secretary: Harrison Church (Great Britain). 15 communications.

Section VI, *Historical Geography and the History of Geography*. Presidents: Roberto Almagià (Italy) and Joaquim Bensaúde (Portugal). Vice-president: Damião Peres (Portugal). Secretary: Angela Codazzi (Italy). 10 communications.

Section VII, *Methodology, Teaching, and Bibliography*. President: A. Cholley (France, absent). Vice-presidents: Christovam Leite de Castro (Brazil) and Charles Burky (Switzerland). Secretary: Alice Garnett (Great Britain). 31 communications.

The communications (or papers) presented before the Sections dealt with 30 "questions" (three to six for each Section) which had been announced in advance of the Congress.

Most of the communications presented before Section I were reports on recent maps and cartographic activities. Sheets from various striking new maps and atlases, notably of Great Britain, Switzerland, Denmark, Belgium, and Portugal, were shown and described. The progress of cartography in Canada and the United States since 1938 was broadly reviewed. The Section congratulated British geographers and cartographers on the splendid series of new maps of Great Britain, 1 : 625,000, published by the Ordnance Survey, showing the principal facts concerning material resources and population. A report, illustrated by lantern slides, was given by Louise A. Boyd on the survey work of her Arctic expeditions of 1937 and 1938.

"Questions" were discussed pertaining to techniques for the representation of relief and of flat and wooded country on maps, and effective papers on this matter were read by representatives of the Institut Géographique National of France. The Section as a whole declared its support of proposals to establish a commission of the International Geographical Union to review the International Map of the World 1 : 1,000,000, more especially with a

view to its use as a base for the mapping of ecological and statistical data, and a commission to study and encourage the production of a population map of the world on the scale of 1 : 1,000,000. In addition, it was the sense of the Section that the International Geographical Union should be urged to secure the cooperation of agencies of the United Nations in cartographical matters, especially in connection with the establishment of an approved system of standardized conventional signs for use on maps wherever practicable and with the development of a standard international terminology that would enable maps to be classified according to their degree of precision.

Mention should also be made of the Cartographic Exhibition on display in the building in which the Section meetings were held. The largest and most comprehensive exhibit was furnished by the United States; it illustrated types of maps produced, and processes of surveying and map production employed, by various government agencies; also the work of private institutions, such as the American Geographical Society and the National Geographic Society, and of individuals, notably R. E. Harrison, A. K. Lobeck, and Erwin Raisz. The recent cartographical output of Canada, France, Belgium, Switzerland, Brazil, Italy, and Portugal was well represented by many fine maps and atlases. Two Portuguese maps on the large scale of 1 : 1000 attracted attention. One, issued in 1931 by the Forest Service, showed the location and species of every tree in a small area; the other showed for parts of Lisbon roof forms in red, trees (with their shadows) in green, and relief by contours at intervals of one meter.

In Section II a vigorous discussion of the "question" pertaining to the modeling of granitic landforms by climatic agents occupied a whole session. Much interest was also shown in "questions" concerning pediments in arid and semiarid regions and recent structural deformations as influencing the sculpturing of landforms. The Section recommended the following topics for discussion at the next Congress: climatic factors bearing on biogeography; periglacial morphology; the nature and speed of the morphological processes of erosion and sedimentation; estuaries and submarine relief; erosion and deposition; and the exact amount, causes, and morphological, biological, and human consequences of changes in the surface level and water economy of fluctuating lakes, particularly in Africa. Throughout the sessions there was animated discussion by the representatives of the active school of French geomorphologists. The failure of American geomorphologists to participate in the work of the Section is to be regretted.

All the 11 communications submitted to Section III were presented by French, Spanish, or Portuguese geographers. Six papers dealt with the origins of the vegetation of the Iberian Peninsula, two with the origins of vegetation elsewhere, one with the introduction of exotic plants into France, and two with the mapping of vegetation. Incidentally, it may be mentioned that the President of this Section, Professor Gaussen, gave a sprightly and humorous field exposition of the *garigue* and *maquis* vegetation of the Serra Arrábida to the geographers who took part in the excursion to that range (see below).

The "questions" considered in the sessions of Section IV bore on various aspects of pastoral life, rural population, rural habitations, maritime fisheries, irrigation, soil erosion and deterioration, and town planning. It was shown that both in Turkey and in Norway modern developments in transportation and communication have facilitated the age-old movements of transhumance. In the discussion of a paper on rural dwellings in Spain, the need for studying rural habitations in relation not only to the types of terrain but also to the periods of construction was brought out. The primitive economic organization of the fisheries of the

Gulf of Lions and their adjustment to climatic conditions were described in a fascinating way. Other papers dealt with the recent development of rice cultivation on a large scale in the delta of the Ebro, irrigation in Afghanistan, changes in the East Midlands of England due to the extension of coal and iron mining into areas until recently entirely rural, the determination of "hinterlands" of market towns in England on the basis of bus routes, and difficulties in mapping rural population in Canada. A special feature was a discussion of a comprehensive project put forward by Samuel Van Valkenburg (Clark University, U.S.A.) for a world survey or inventory of land resources, for the consideration of which a commission of the International Geographical Union has been established.

Of the 15 communications presented before Section V, eight dealt with parts of Africa where colored populations predominate ("Black Africa"), one with North Africa, four with South America, and two with colonial territories in other parts of the world. The conclusion was reached that French West Africa and other parts of "Black Africa" seem to be capable of supporting many more people than they do today without any radical upsetting of the techniques and functioning of the existing indigenous populations. Professor Robequain, the President, believes that this Section should be replaced by one on the "Human Geography of Tropical Countries Exclusive of Deserts," since the "Geography of Colonization" is too broad and vague a concept for adequate treatment.

The most important "question" discussed by Section VI dealt with the cataloguing of old maps in large libraries. After reports had been presented on the material available in the national libraries at Paris and Rome, the British Museum, and the libraries of Oxford, Cambridge, and other universities, the Section voted to approve a project for cataloguing by a uniform system manuscript maps dated to the end of the sixteenth century. A commission of the International Geographical Union will promote the work. The Section also received a communication bearing on the distribution of population in Portugal as revealed through the study of prehistoric monuments, and four communications on the transformation and evolution of geographical ideas brought about by the great voyages of discovery, notably those of the Portuguese before the end of the eighteenth century. The development of the configuration of Africa and the Indian Ocean as shown on certain Italian maps of the fifteenth and sixteenth centuries was explained.

In Section VII most of the discussion centered around two methodological "questions" concerning the aspects of physical and human geography that should be treated in studies of regional geography and the definition and classification of geographical divisions. Much interest was also displayed in a paper on the status of geographical education in Britain, particularly as affected by the Education Act of 1944. Two American motion pictures were shown at one of the meetings of the Section. One, presented through the courtesy of the United States Navy, was "The Secret Land," already familiar to audiences in the United States, which depicted the work of the Navy's Antarctic Expedition of 1946–1947. The other picture illustrated methods of graduate field instruction in geography developed through the cooperative activity of Northwestern and Syracuse Universities, which for several years have jointly operated a field camp in the dairy country northwest of Milwaukee, Wis.

Field Trips

Members of the Congress were given ample opportunity to become acquainted with the geography of Lisbon and its environs. On Tuesday, through the kindness of the President of the Administrative Council of the Port of Lisbon, the Congress made a boat tour along

the entire length of the city's busy water front and the opposite shore of the Tagus, with its striking buff-colored cliffs. On the following morning a fleet of buses took the Congress to various high points overlooking the city and the surrounding country, where the views were interpreted geographically in lucid French by Professor Ribeiro. Those who participated in this pleasant excursion will long remember the whites and pastel colors of walls, the red-tile roofs, and the rich greens of open fields.

On Sunday the members were offered a choice of two all-day bus excursions. One, led by Professor Ribeiro, went to the south of Lisbon—to the bleak, wind-swept Cape Espichel, the redolent maquis-covered slopes of the Serra Arrábida facing the sea, and the hilltop Palace of Palmela. The other, led by Dr. Virgínia Rau and M. Georges Zbyszewski, visited the amazing castle-crowned crags of Sintra, the seaside resorts of Estoril and Cascais, and the grand Cape Roca, westernmost point of the continent of Europe.

A six-day excursion, led by Dr. Virgínia Rau and M. Georges Zbyszewski, to Estremadura and Ribatejo, within a distance of some 60 miles to the north of Lisbon, was carried out during the week before the Congress. It will long linger among the pleasant memories of the participants. Four days were devoted to the varied country of ridges, structural basins, and low plateaus that lies between the Atlantic and the Tagus bluffs—a land of vineyards, olive orchards, and cultivated fields, of well-tended woodlands and "bare fallow." Old, loosely clustered villages, red-roofed and white-walled, predominate. Every cultivable plot is scrupulously enclosed, every available bucketful of subsoil water uplifted. A different world was visited east of the Tagus. Here, on the flood plain and adjacent sandy terraces, are great estates dating from the times when military-religious orders established themselves after the reconquest from the Moors. Recently introduced peasant colonists live in villages of rectangular pattern and on scattered holdings, each around its irrigation well, and cattle and horses roam the open grasslands near the river. The human interest of these contrasting regions was skillfully brought out by Dr. Rau, with appealing humor and an intimate knowledge of terrain and people—laborer and landlord, fisherman and peasant, cowboy and townsman. Equally able in a different way were M. Zbyszewski's quiet, clear, and logical demonstrations of geological structures and their associated landforms.[1]

Four other excursions, each to last about a week, were in the field at the time when this report was written (at Sintra, April 17), and a two-week excursion to Madeira was scheduled to set forth immediately upon their return. Scholarly guidebooks (*livret-guides*) in French, illustrated with photographs and maps and especially prepared for certain of the longer excursions, were distributed to persons registered at the Congress.

[1] This paragraph, a condensation of a report on the excursion kindly furnished by Professor Arthur Geddes, is included because of the special interest of the excursion to the relatively large number of Americans (17) who participated in it.

THE AMERICAN GEOGRAPHICAL SOCIETY

The March Lectures

The third of the Series B lectures (see the *Geogr. Rev.*, Vol. 39, 1949, p. 144) was given on March 1 in Room 502 of the Engineering Societies Building, 29 West 39th Street, Mr. Raye R. Platt presiding. Dr. Lester E. Klimm, professor of geography at the Wharton School of Finance and Commerce of the University of Pennsylvania, spoke on "What Is Modern Geography?" Professor Klimm's abstract follows:

Modern geography as this writer conceives it is not some startlingly new creature; it is essentially the same as Strabo's geography. Rather than attempting to define geography so as to be inclusive and exclusive, this writer prefers the approach of Fenneman in his presidential address before the Association of American Geographers in 1918. If geography were dead, many of the systematic sciences might well take over the facts of distribution of their phenomena, but there would still be need for a field of knowledge that would concern itself with the description of all conditions in an area. Although this is geography and nothing else, it does not follow that nothing else is geography. This is but a central core with much useful activity about the periphery.

Because every square foot of the earth's surface is different in some way from every other square foot, the geographer's job of making a useful areal generalization is not easy. Man sees the territory about him on a large scale but reads regional descriptions or maps on a small scale; and transfer from the one scale to the other is difficult. Truth in geography is relative to scale, a generalization that has not been universally recognized.

Purely descriptive geography yields no universals, no laws, yet it is no less important therefor; indeed, stressing the uniqueness of its facts—that is, facts *in place*—may be one of geography's important contributions to knowledge. Most of the earth sciences have gone through stages from the observation of a few facts, the derivation of laws from those facts, the use of the laws to interpolate between the observed facts and to extrapolate beyond them, to, finally, a recognition that ultimate reality is so complex that there may well be a stage where relatively "complete" description of unique facts is the final truth.

There is a common misconception that the world is fully explored and that there is little more gathering of geographic data to be done. This is only relatively true on the very smallest scale, and it is increasingly less true on larger scales. The focusing of attention on the small area reveals how few data are available. Our generalizations are made on one semantic level, and we try to use them on another.

But the human mind is probably incapable of viewing distributions without attempting to explain relationships. Several approaches to geography have grown up that put these searchings for relationships in the forefront and thus serve as useful short cuts to geographic analysis. The concept of "geography as human ecology" concentrates attention on man and his activity and examines the surroundings for explanations. A not always realized confusion arises from the fact that man is both an animal with physiological attributes and a sentient creature with social and mental attributes. There is much discussion of "determinism," "relationship," "possibilism," "adjustment," and "ecology" without differentiation between physiology and sociology.

The classic separation of time and space relationships cannot be maintained. Even if geography were restricted to the description of present conditions in an area, the stage of

development of those conditions and differences in the pace and velocity of circulation are present facts. So, too, history takes place in space.

The fourth and last of the Series A lectures of the current season was given at a meeting of the American Geographical Society on March 15, at the auditorium of the Engineering Societies Building, Dr. John K. Wright, Director of the Society, in the chair. Mr. Karl Robinson addressed the Society on "China Journey." Mr. Robinson spent a number of years in China before the war and returned in 1946 to produce a color film of the Chinese people and their way of life. His travels took him to various provinces in both North and South China, where he recorded conditions in the cities and rural areas.

The fourth and last of the Series B lectures of the current season was given on March 29, in Room 502 of the Engineering Societies Building, Dr. Richard U. Light, President of the Society, presiding. Dr. Edward Ullman, assistant professor of regional planning at Harvard University, spoke on "The Railroad Pattern of the United States." Professor Ullman's address was published in the April number of the *Geographical Review* (pp. 242–256).

Talk by Mr. William H. Phelps, Jr.

On Friday, May 20, Mr. William H. Phelps, Jr. gave an informal talk at the Society's building and showed his excellent color film of last winter's expedition to Serranía Parú, in the Venezuelan Guayana. It will be recalled that Mr. Hitchcock accompanied Mr. and Mrs. Phelps on the journey as geographer and geologist of the party. The film vividly demonstrated once again the beauty, fascination, and scientific interest of both the riverine and the mountain landscapes of this little-known region.

Memorial to Mr. Frederic C. Walcott

At the meeting of the Council of the Society held on May 24, 1949, it was unanimously resolved that the following memorial expressing the Society's deep sense of loss through the death of its former Vice-President, Mr. Frederic C. Walcott, be entered in the permanent record of the Council and that copies be sent to Mr. Walcott's family:

Frederic C. Walcott, descendant of an old New England family, was born in New York Mills, near Utica, N. Y., in 1869, and died in Stamford, Conn., on April 27, 1949. His career throughout was marked by his devotion to public welfare. During the First World War he gave up his business interests to work on the Belgian and Polish relief programs and as aide to the Federal Food Administrator. After a period in the State Senate he served as United States Senator from Connecticut from 1929 to 1935. He headed the Senate Conservation Committee and was responsible for much of the basic federal legislation on conservation. Although he engaged in many other activities, conservation was the dominant interest of his life. He was president of the Connecticut State Board of Fisheries and Game for several years, and he later became State Welfare Commissioner. The depth and sincerity of his belief in conservation ring out in his addresses before the annual conferences of the American Wildlife Institute, of which he was president for many years. His "keynote speech" at the Toronto meeting in 1942, "against waste and for the intelligent use of our resources," was a stirring challenge on "a terribly important occasion."

Mr. Walcott became a Fellow of the Society in 1923 and was elected to the Council in that year. He served as Foreign Corresponding Secretary 1928–1940, as Vice-President from

1941 until his resignation in 1948, and as chairman of the important standing committee to nominate persons to fill vacancies in the Council, 1926–1946. His scientific interests took him to various parts of the world. Fellows of the Society will remember as an outstanding contribution to the *Geographical Review* (Vol. 15, 1925, pp. 345–366) his report on an expedition to the Laguna Colorada in southern Bolivia, dealing primarily with the bird life but richly suggestive of all the geographical aspects of a little-known land.

Death of Stanley F. Smith

The Society has sustained a severe loss in the death on May 9 of Stanley F. Smith of its cartographic staff. Mr. Smith came to the Society from England in July, 1927, and shortly thereafter was assigned to the *Geographical Review*. The work on the *Review* continued to be his main occupation, but he also drew maps for other publications of the Society and for other organizations, including the British Information Services. During the war he was engaged as a consultant to the Division of Geography and Cartography of the Department of State, where his "quick appreciation of the fundamental problems encountered in the presentation of complicated political and economic information proved most helpful." He attended the United Nations Conference on International Organization at San Francisco, 1945, as Cartographic Officer to the Adviser on Geography of the Secretariat. He also gave instruction at Columbia University in government-sponsored courses in map drafting. Through these and other activities his work became widely known, and many tributes have been paid to it.

Mr. Smith's drawing was distinguished by qualities of integrity and style. As we pointed out in the April editorial (p. 180), a well-drawn map is art concealing art. Behind seeming simplicity may be hours of compilation and checking and study in craftsmanship. Moreover, the draftsman for a periodical publication must continually make compromises with time and space. Mr. Smith had acquired great skill in translating large-scale, complicated maps in color into black-and-white text maps. It is difficult to single out examples where there is so much choice, but from recent issues of the *Geographical Review* we might instance the land-use map of the Westchester-Fairfield area prepared when the site for a permanent seat of the United Nations was under consideration (July, 1946), the map of northeast London (July, 1945), and the Burmese settlement maps (October, 1945). Where circumstances permitted color and a large scale, we find such a fine product as the map of Muir Inlet, Alaska (July, 1947). Among Mr. Smith's drawings for the Society's *Special Publications* the maps accompanying "Focus on Africa" and "The Face of South America" may be mentioned as illustrations of the art of studied simplicity. Other well-conceived examples will appear in the book on the geography and demography of Europe now in preparation.

As a colleague Mr. Smith will be particularly missed for his delightful wit, his ready cooperation, and his lively understanding. His maps are a permanent memorial.

Notice to Fellows and Subscribers

Return to the Society of copies of any of its publications that are no longer needed would be greatly appreciated.

GEOGRAPHICAL RECORD

NORTH AMERICA

CHANGES IN THE GEOGRAPHIC-ECONOMIC STRUCTURE OF THE UNITED STATES. Although the colossal industrial establishment of the United States includes nearly half of the manufacturing capacity of the globe, its extreme complexity has tended to discourage geographic analysis. Yet, if industrial production is in truth the touchstone to the brave new world of the future, it deserves to be a principal concern of cultural geography.

With a refreshing perspective Jean Gottmann has recently sketched the shifting geographic structure and regional character of the economy of *la grande République* (Changements de structure dans la géographie humaine des États-Unis, *Annales de Géogr.*, Vol. 57, 1948, pp. 131–145 and 219–226). He points out, for instance, that the traditional orientation toward interior markets and sources of raw materials is threatened by the entirely new conditions imposed by recent world events. America's new responsibilities in a troubled world call for an expanding foreign trade in which American capital and manufactured goods are to be exchanged for increasing amounts of strategic minerals, iron ore, petroleum, tropical foodstuffs, and quality European manufactures. Growing concern for the conservation of our nonrenewable resources will further encourage the import of raw materials. Under such conditions transport costs of American manufacture will be lowest at tidewater. The intensified drive of the Lake States for realization of the long-delayed St. Lawrence Waterway Project is but one recognition of the increasing necessity for easy access to foreign raw materials and foreign markets. The recent successful crusade by the South and West for a more equitable freight-rate structure may be another.

Two narrow coastal zones, one in the southwest corner of the country (California) and the other in the extreme northeast, are "the two poles of the economic and cultural life of the United States," which are seen as the principal benefiters from this centrifugal movement of industry and population toward the shores of the continent. The author discerns a certain decentralization of the industries of transformation and of population from the Chicago-Boston-Washington triangle in recent years, stemming especially from the wartime requirement for simultaneous maintenance of operations and supply bases on both oceans. Postwar programs of overseas aid and rehabilitation continue this effect.

It is especially California, he says, rather than the more mature Atlantic coastal zone, that offers promise for future growth. Alone among the American states it is a true "province" in the European sense, with a well-developed regional personality. This reviewer, however, would emphasize that so far the unparalleled urban growth of California (really two metropolitan nodes separated by nearly 400 miles of inhospitable coast; see James J. Parsons: California Manufacturing, *Geogr. Rev.*, Vol. 39, 1949, pp. 229–241) must be explained less in economic terms than in the restlessness and rootlessness of a segment of modern American culture, with its rejection of the tried and traditional and its emphasis on "ballyhoo," creature comfort, and cultism which Carey McWilliams effectively analyzes in "Southern California Country" (Duell, Sloan & Pearce, New York, 1946). Uncompromising faith in the ability of man to transform Nature to his own ends, a characteristically American attitude, is nowhere more in evidence than here. Nevertheless, serious deficiencies in such basic raw materials as coal and iron ore emphasize the thinness of the state's resource pattern. Nor is the often-repeated promise of an expanding new commerce with the Pacific

very reassuring. In 1947 the Port of San Francisco handled one-third less tonnage than in 1929. For several years there has been no regularly scheduled steamship passenger service between any United States west-coast port and either Australia or New Zealand.

Gottmann does not deal with another important set of considerations, which may counteract any tendency toward increased coastal concentrations of industry and population. As long as the specter of war persists, military strategy and business acumen alike must give attention to the advantages of dispersion away from congested vulnerable coastal cities. From this point of view it is especially the Gulf-coast region that perhaps stands to gain most in population and industrial stature.—JAMES J. PARSONS

THE CARIBBEAN COMMISSION'S REPORT ON SUGAR. In 1942 an Anglo-American Caribbean Commission was created to encourage social and economic cooperation between the United States and the United Kingdom in the Caribbean and to avoid duplication of research in that region. In 1945, France and the Netherlands joined the organization, and the name was changed to Caribbean Commission. The Caribbean Research Council, established by the Commission in 1943, has set up various committees, among them a Committee on Agriculture, Nutrition, Fisheries and Forestry. This body is undertaking a series of crop studies, the results of which are published in the *Crop Inquiry Series*. Number 6 in the series is "The Sugar Industry of the Caribbean" (Washington, D. C., 1947).

The report furnishes a comprehensive survey of the industry as it is now carried on in the British and American possessions (Cuba, of course, is not included, and data on the French islands will be published later as a supplement). Each island is treated individually under a number of headings: historical sketch, acreage, production, yield, rainfall, soil conditions, manurial systems, diseases and pests, mechanization, organization of the industry, research, conditions of marketing, selling price, by-products. This descriptive pattern brings out the many differences between the islands—in rainfall, for instance. There are differences from island to island and between the windward and leeward sides of single islands, and on some islands there are wide annual fluctuations. In Grenada rainfall in the cane-growing areas ranges from 30 to 60 inches, and one station has shown a range from 30 inches (1940) to more than 70 inches (1938). The variation in rainfall probably explains the large fluctuation in production—too heavy a rainfall plays havoc with a crop. In Jamaica there is a difference in rainfall of as much as 30–40 inches between the northeast and south coasts; yearly averages for the island as a whole range from 116 inches (1933) to 60 inches (1938). Such fluctuations are to some extent the result of the hurricane rains. In Puerto Rico almost every field operation except harvesting has been mechanized; in Barbados, on the other hand, there is little mechanization. The average size of farms or estates varies greatly: in Barbados only six out of 280 plantations are larger than 500 acres; in Jamaica only 10 estates are less than 5000 acres.

There have been great changes in absolute and relative production in the islands; in some, sugar cultivation has vanished or is insufficient to supply local needs. In St. Lucia in recent years total sugar production has ranged from less than 3000 tons (1921) to 8000 tons (1940); in 1830 export from the island was 50,000 tons.

The report states that the recent increase in production is due not to an increase in the acreage under cane but to technological progress. In Trinidad production more than doubled in the period 1920–1945. Advances have been made in the fight against disease, in the introduction of better commercial varieties, and in the use and application of fertilizers. The

most noteworthy feature of the industry today would seem to be the research projects being undertaken in Barbados and Trinidad. A detailed account of the work being carried on at these stations is given in appendixes to the report, and there is an extensive bibliography.

SOUTH AMERICA

PLEISTOCENE CONDITIONS IN SOUTHERN PERU. Recent studies by C. N. Fenner have shed new light on the nature and extent of Pleistocene volcanism and glaciation in the Arequipa region of southern Peru.

Throughout the Pleistocene, volcanism was active in this region, yielding pumice, andesitic lava flows, and huge deposits of rhyolitic tuff, to which the name *sillar* is given locally. The sillars have been known to geologists for many years, but their true nature and their magnitude have not been understood. Because Fenner had studied and made clear the origin of similar material produced by the Katmai eruption of 1912, he was able to identify the sillars as incandescent tuff deposits of the Katmaian type (Incandescent Tuff Flows in Southern Peru, *Bull. Geol. Soc. of America,* Vol. 59, 1948, pp. 879–893). In such eruptions the magma is highly charged with gases, but instead of issuing explosively it "boils over" and, as a mixture of solid particles completely surrounded by gases, flows downslope like a fluid, accumulating in the lowest places. It is not surprising, therefore, that the sillars of southern Peru have sometimes been interpreted as mudflows.

Later in Pleistocene time glaciation set in. Its extent is a matter on which agreement has not yet been reached. Northeast of Arequipa three great volcanic peaks rise, from bases about 8000 feet above sea level, to maximum elevations of more than 18,000 or 19,000 feet. In their upper parts there is indisputable evidence of glacial erosion in the form of cirques and troughs. These are concentrated on the southwest side, which is in accord with present conditions of greater precipitation and more abundant vegetation on this side. But what was the lower limit of the glaciers? Below the glacially eroded features are huge heaps of unsorted detritus, containing some very large boulders. These masses reach the lower slopes of the volcanoes and in some places extend out on the pampas. It was from them that coarse debris was washed out to fill great gullies eroded in the sillars in a preglacial pluvial period. Although volcanic discharges, various types of mass movement, and stream transport may have contributed to their accumulation, Fenner believes that the unsorted masses are dominantly glacial moraines and that the valley fill derived from them is glacial outwash (Pleistocene Climate and Topography of the Arequipa Region, Peru, *Bull. Geol. Soc. of America,* Vol. 59, 1948, pp. 895–917. His interpretation is based on composition and location, not on surface form; for if the outward form of moraines was ever present, it has been destroyed by erosion. This is in line with Fenner's general conclusion that "there is hardly a surface to be found in the Arequipa region, whether of mountain slopes, of moraines, of pampas, or of river terraces, that is not either wholly the result of erosion or has not been fundamentally modified by it."

If the unsorted debris is morainal, the Pleistocene glaciers reached here unusually low limits for a region only 16° from the equator. Fenner attributes this to the influence of volcanism. The steep slopes of the volcanoes would cause rapid movement of the glaciers and would permit their maintenance at lower levels than would be possible on gentle slopes. Furthermore, from time to time volcanic eruptions may have blanketed the glaciers with debris, which protected them from melting. Of this we have no direct evidence, for such material

would now be mixed with moraine from other sources; but pumice layers intercalated in the valley fill indicate frequent volcanic eruptions, and if the fill is outwash, these eruptions occurred during the glacial period. Fenner's interpretation therefore calls upon extensive volcanism, both before and during glacial time, to account for extensive Pleistocene glaciation in southern Peru.—ANASTASIA VAN BURKALOW

EUROPE

ICELAND: STRATEGIC ISLAND. It has been appositely remarked that "the economic and ideological currents flowing today from the great nations of the world end in waves on very distant shores." Iceland is a case in point. Before the war this small, isolated country was in serious economic difficulties (W. C. Chamberlin: Economic Development of Iceland through World War II, *Columbia Univ. Studies in Hist., Econ. and Public Law*, No. 531, 1947). Lacking many basic raw materials, she was heavily dependent on imported goods, yet her export trade, based largely on the sale of salt fish to Spain and Italy, had been badly affected by unsettled conditions in those countries during the late thirties. As a result, Iceland suffered under an almost ruinous foreign debt. The war, however, effected drastic changes. Occupying troops brought a flood of money and a crying demand for labor at high wages; eventually, through a combination of circumstances too involved to detail here, an astonishing accumulation of foreign credits was built up.

An evaluation of postwar conditions in Iceland points up the contrast (Iceland: Its Importance in an Air Age, *The World Today*, Vol. 4, 1948, pp. 297–307). Today, spending her war credits, Iceland has been able to restore and expand her fishing fleet, improve and extend her road system, and construct bridges and hydroelectric plants, and "has built more permanent houses per capita than any other country in the world." The construction of airfields and harbor works underlines the fact that she is now "regarded as one of the key points in world communications and strategically one of the most important countries on the globe."

Increasing awareness of, and interest in, the country that Agnes Rothery has described as "the delight of geologists, the inspiration of painters, the acid test of automobiles, and the downfall of otherwise rational writers of prose" is shown by the number of publications dealing with various aspects of Icelandic life and landscape. These range from a concern with physical manifestations such as geysers (T. F. W. Barth: Geysers of Iceland, *Trans. Amer. Geophys. Union*, Vol. 28, 1947, pp. 882–887) and local climatic variations (G. H. T. Kimble and others: Wind in Icelandic Fjords, *Bull. Amer. Meteorol. Soc.*, Vol. 27, 1946, pp. 216–223) to literature (Stefán Einarsson: History of Icelandic Prose Writers 1800–1940, *Islandica*, Vols. 32–33, 1948) and contemporary culture (Agnes Rothery: Iceland: New World Outpost, Viking Press, New York, 1948).

AFRICA

THE NUBA OF KORDOFAN. On the vast clay plain that constitutes the central part of the Anglo-Egyptian Sudan isolated rock hills rise abruptly from the black cotton soil. Generally they are surrounded by an aureole of reddish, lighter-textured loam. Southeast of the Darfur-Kordofan upland a circular cluster of these hills is known locally as the Nuba Mountains; they are differentiated from the surrounding country not only by relief but also by a slightly heavier rainfall and a more luxuriant scrub vegetation.

Into this region migrated a Negroid group known as the Nuba, distinct from the surrounding Arabs and Nilotes, in both appearance and language. They are the subject of a recent study by S. F. Nadel (The Nuba: An Anthropological Study of the Hill Tribes in Kordofan, Oxford University Press, London, New York, Toronto, 1947). Since their arrival they have occupied mainly the hills. The hillside locations provided somewhat superior sites for perennial wells in a poorly watered country and, more important, offered protection from the raids of slavers or the attacks of neighboring tribesmen. Today there are three types of farms among the Nubas: the house farm, the hillside farm, and the far farm.

The house farm lies within the village, a scattering of circular mud-and-wattle huts with conical thatched roofs. Except where the village is on a tableland or in a mountain valley, the farm is terraced. Permanent agriculture is practiced, and fertility is maintained by the application of manure. Maize, millet, light sorghum, and secondary food crops such as pepper, melons, cucumbers, and okra are produced.

The hillside farm, like the house farm, is terraced, but usually it is not fertilized. Although a crude sort of crop rotation is practiced, fertility declines, and notwithstanding the great amount of labor expended on building the terrace, the land is abandoned or allowed to lie fallow for a period of years. The usual crops are the staples such as heavy sorghum, beans, sesame, and peanuts.

The far farm, on the plain, is a relatively new feature, in existence for about a quarter of a century. The same staple crops are produced as on the hillside farm and, in addition, a new crop, cotton. Migratory agriculture is practiced here, as on the hillside farm, and has led in the past few years to an increase in land disputes between individuals or villages, and especially between the Nuba cultivator and the Arab herdsman. The heavier soil has necessitated new farming techniques and, in some places, a modification of the traditional agricultural tool, the hoe.

Despite the close similarity of environment of the Nuba tribes and a similarity of economic life, there is great diversity of language and culture. Adjacent tribes are in many instances unintelligible to each other. Culturally the ten tribes may be divided into four groups on the basis of patrilineal or matrilineal clans, simple or symbiotic clan structure, and the presence or absence of a shamanistic cult.

Dr. Nadel's book was written, in part, as an aid in "the practical tasks of government." It may be regarded as one of a series of anthropological studies encouraged or financed by the Sudan government. Two of the larger works, published earlier, are "Pagan Tribes of the Nilotic Sudan" by Charles G. and Brenda Z. Seligman (1932) and "The Nuer: A Description of the Modes of Livelihood and Political Institutions of a Nilotic People" by Edward E. Evans-Pritchard (1940). Like its predecessors, the present volume is impressive in data. Its author is to be congratulated on what he has accomplished under difficulty in both the collection and the presentation of his material. That the Sudan government, operating of necessity on a limited budget, still sponsors such work as this may explain to no small extent why it is the object of so much admiration on the part of those of us who have visited the country and have had the opportunity to observe it in operation.—H. THOMPSON STRAW

A NEW EGYPTIAN PERIODICAL. A new member in the growing family of geographical periodicals has recently appeared in Cairo. It is the *Bulletin de la Société d'Études Historiques et Géographiques de l'Isthme de Suez*, an organization formed in Ismaïlia in January, 1946, with the threefold purpose of (1) developing historical and geographical culture,

(2) communicating scientific information to the learned societies of Egypt and other countries, and (3) studying in particular the Isthmus of Suez and its neighboring regions.

Volume 1 of the *Bulletin* (dated 1947, published 1948) contains, among other items, an article on the foundation and aims of the new society by Jean-Edouard Goby, two articles on ancient historical sites (Daphnae and Kantara), one on the postal service of the Isthmus at the time of canal construction, and one comparing certain features of the Suez and Panama Canals. Material in the *Bulletin* is arranged under five general headings: Chroniques et Généralités, Mémoires Originaux, Comptes-Rendus Bibliographiques, Informations et Communiqués Divers, and Index et Répertoires. All articles bear a number that refers to a decimal system of subject and regional classification described in detail in Volume 1. The Society also issues, though not in printed form, *Notes d'Information*, of which 10 numbers appeared in 1946–1947.

ASIA

RYUKYU ISLANDS, THE RECORD OF A CHANGING CULTURE. Before World War II, American knowledge of the Ryukyu Islands was slight indeed. Then came the war, and suddenly there was a great need for information regarding this little-known island chain. From Yale's Cross-Cultural Survey and data provided by various federal intelligence agencies a Navy Civil Affairs Handbook was compiled, similar to those that were hastily prepared for other critical areas. In "The Ryukyu People: A Cultural Appraisal" (*Ann. Rept. Smithsonian Instn. for 1947*, Washington, 1948, pp. 379–405) Marshall T. Newman and Ransom L. Eng bring together much of the information from these sources, particularly the details regarding the people and their culture.

The study deals briefly with the physical geography. The islands are handicapped by hilliness and by soils that average only fair in quality. Rainfall is "sufficiently heavy to stimulate lush natural vegetation," though "scarcity of natural reservoirs and the great depth of the ground-water table" make water supply a major problem. Critical in the climatic picture are the typhoons, for which the largest island, Okinawa, is especially famous.

The authors trace the long rivalry between China and Japan in the Ryukyu Islands, a rivalry that culminated in formal anexation by Japan in 1871. The Chinese brought in the sweet potato and sugar cane, which were to become of importance in later years. And the Chinese strongly influenced the culture of the upper classes in the native social hierarchy, whereas the Japanese, through subdividing the land, practically did away with the upper classes. In spite of the fact that the islands were long governed as part of Japan, the population was never really assimilated. The top positions were held by Japanese, and the Ryukyuans were looked down upon as uncouth rustics.

An analysis of the culture that prevailed just before World War II makes up the longest section of the article. Food habits and diet, technology and art, the sociopolitical pattern, the life cycle, and the Ryukyuan's world view are among the topics discussed. Probably of greatest interest to the geographer is the food economy, of which crop production was by far the dominant phase. During most of the Japanese period the sweet potato was the great food crop and sugar cane the cash crop, but in the 1930's a trend toward larger rice production was discernible. Animal husbandry and fishing were minor activities, and manufacturing was primitive and largely local. The islands were badly crowded, and thousands of people left each year in search of better opportunities elsewhere.

The Ryukyuans were profoundly affected by World War II. Thousands of the men were used as military conscripts and war workers at various Japanese bases, and "Okinawa and adjacent islets felt the smashing effect of a shooting invasion." Since the war there has been yet another outside influence: the United States government has undertaken the problem of rehabilitating the Ryukyu people.—RAYMOND E. MURPHY

AUSTRALASIA AND OCEANIA

TRENDS IN THE POPULATION PATTERN OF FIJI. Many areas in the tropics have been developed as a direct result of the introduction of a labor force from India, among them Fiji. At the present time Indians make up the largest percentage of the total population. The latest census report of the colony, far more comprehensive than its predecessors, contains vital information on the social and economic life of the Fijian natives and of the alien groups that must now be considered a permanent part of the population (J. W. Gittins: A Report on the Results of the Census of the Population, 1946, *Legislative Council Paper No. 35*, Colony of Fiji, Suva, 1947).

The Fijian population decreased from 114,748 in 1881 to 84,475 in 1921—largely as a result of epidemic diseases—and then gradually recovered to its present total of 117,488. The Indians, on the other hand, have steadily increased. In 1881 they numbered 588; when the indenture system came to an end in 1916, they numbered 62,837, though more than a third returned to India after their 10-year contract expired. They now total 120,063, or 46.24 per cent of the population of the colony, and it is important to note that 84.5 per cent of them were born in Fiji. If the present rates of increase continue for the next decade, the Indians will outnumber the Fijians by at least 20,000.

The marked contrast between the birth rates of the Fijians and the Indians reflects the essential difference in the social backgrounds of the two peoples. The Fijian woman marries much later in life, has fewer children, and apparently takes less care of them than the average Indian woman: if the Fijian mother could be taught to feed her children on milk rather than on taro, there would be a decrease in the high infant-mortality rate. Many Fijian women enter public life and remain independent. In 1946 there were 960 in "paid" occupations, as compared with 260 Indian women. The gradual breakdown of communal living among the Fijians, which was accelerated by the impact of the recent war in the Pacific, also tends to bring a greater independence to the Fijian woman.

At the time of the arrival of the Indian "the Fijian had abundance of everything, food, housing materials, land, very little need of, or use for, money, and from a social point of view lived in a regulated and ordered community, bound together by the strongest ties of customs and traditions." The Indian, accustomed to fight against food starvation and economic poverty in his native land, introduced his own customs and social ideas based on the freedom of the individual or family unit. Life in Fiji proved to be less of a struggle, and it was not long before most of the paid positions in commerce and industry were occupied by Indians. The Fijians gradually became aware that the Indians were gaining economic ascendancy, and within the last 25 years they have entered into commercial occupations and industries. The increase in the number of Fijians living away from their villages is a reflection of the gradual change from a communal way of life to a more independent wage-earning type of economy—5.25 per cent in 1921, 21.85 per cent in 1946.

The maps in the current census report are not as useful as those in the smaller report

on the census of 1936. One map shows census districts, another population density based on total areas of provinces, a third population density of the Suva Peninsula. It is more important, however, to know what parts of each province are more densely populated than others, and the map of population density in the 1936 report gives this information. The earlier report also contains two dot maps showing the distribution of Fijians and of Indians, neither of which has been included in the present report. The official statistics give population density for even the very small areas, such as islands and lighthouses. Two small islands, Mbau and Serua, are reported to have a density of 9333 and 7564 persons to a square mile respectively. On the map they are shown as tiny dots off the coast of Viti Levu and are underlined in red to indicate the very high density of population. Mbau, however, has only 308 persons, Serua 118. Finally, on Solo Lighthouse, about 40 miles south of Suva, there are eight Indians living in an area 0.00023 of a square mile; with statistical accuracy the total population density is officially tabulated as 34,692 persons to a square mile!—GRAHAM H. LAWTON

THE COOK ISLANDS. To the several references to Pacific Islands in this issue of the *Geographical Review* may be added Ernest Beaglehole's article "Social and Political Changes in the Cook Islands" in the December, 1948, number of *Pacific Affairs*. The 14 islands with a land area of some 63,000 acres that make up the group were annexed by New Zealand in 1901. For many years thereafter they continued to be largely isolated from social change; but World War II had its great impact here as elsewhere in the Pacific, creating among the islanders the desire for "more money and more political power." The recent series of labor disputes has a political as well as an economic basis. The islanders are chiefly engaged in subsistence agriculture. To enlarge the economy would require greater diversification of crops and improvement in quality and improved transportation both between the islands and with New Zealand. Land tenure is one of the particular difficulties on the larger islands. There is need for basic surveys on land utilization and on social conditions and services.

PHYSICAL GEOGRAPHY

CLIMATE AND SOIL MOISTURE IN THE TROPICS. Mohr's monumental book on the soils of equatorial regions, which Pendleton translated and saw through the press as a labor of love (*Geogr. Rev.*, Vol. 35, 1945, pp. 335–336), is of no little interest to the climatologist. Mohr distinguishes two climates, atmospheric climate and soil climate (parenthetically, the separation seems to me unwarranted), and directs his attention to moisture conditions and temperature of the soil. Since soil temperature is extremely uniform in equatorial regions, Mohr rightly devotes most of his thought to the seasonal march of soil moisture. He points out that "while it is easy to measure the rainfall with a rain gauge, it is very troublesome to go further into the questions as to what becomes of the water; how much of it runs off over the surface. It is extraordinarily difficult to measure the *evaporation* from a soil surface by direct measurements." He continues: "Meteorological and climatological stations consider evaporation exclusively as an atmospheric phenomenon; and they measure it with conventional fixed evaporation meters, which are flat open vessels, usually of brass; the evaporating surface is pure water, of a temperature approximately that of the atmosphere." Then he asks the question, "Now what will the *evaporation from the soil be?*"

This is a question that has plagued agriculturists, ecologists, soil scientists, and climatologists for a great many years. George Marsh, in his classic analysis of the problem (Man and

Nature; or, Physical Geography as Modified by Human Action, London, 1864), voiced despair: "In discussing the climatology of whole countries, or even of comparatively small local divisions, we may safely say that none can tell what percentage of the water they receive from the atmosphere is evaporated."

Nevertheless, Mohr attempted to find an answer to the question. He found some observations of evaporation from small cylinders filled with soil made at Buitenzorg nearly half a century ago. From these data he established a relationship between evaporation and precipitation which he used to determine the possible occurrence and intensity of a dry period in the soil. The relationship is $E = 60 + .125\,P$, in which the values are for periods of a month and are given in millimeters. This expression says that with less rainfall there will be less evaporation and that with no rainfall evaporation will still amount to 60 millimeters in a month. Obviously this formula is not scientifically sound and cannot have universal application. The dependence of evaporation rates on temperature is well known. However, in the East Indies, where temperature is uniform through the year and precipitation is high, the relationship seems to have worked well, and from it Mohr constructed an exceedingly interesting climatic map dividing Java regionally according to the length and intensity of the dry season.

In recent years F. Hardy has intensively studied the soil-water-plant relation at the Imperial College of Tropical Agriculture in Trinidad, B.W.I. (E. M. Chenery and F. Hardy: The Moisture Profile in Some Trinidad Forest and Cacao Soils, *Tropical Agriculture*, Vol. 22, 1945, pp. 100–115; F. Hardy: Seasonal Fluctuations of Soil Moisture and Nitrate in a Humid Tropical Climate (Trinidad, B.W.I.), *ibid.*, Vol. 23, 1946, pp. 40–49; *idem:* The Evaluation of Soil Moisture, *ibid.*, pp. 66–75; *idem:* Effective Rainfall and Soil Moisture in Trinidad, *ibid.*, Vol. 24, 1947, pp. 45–51). Hardy asserts that "the study of soil moisture relations comprises the most important part of ecological crop investigations." He summarizes the factors that make difficult and inconvenient the field determination of soil moisture and continues: "It should nevertheless be possible to derive soil moisture contents from daily rainfall records, provided suitable and reliable relationships are first established between total and effective rainfall . . . This would eliminate the necessity for determining soil moisture contents directly and would thus prove of great service in the study of soil moisture conditions in remote areas, or for lapsed periods of time during which soil moisture contents had not been directly measured."

To study the seasonal march of soil moisture, Hardy adopted Mohr's method. During the wet season at Buitenzorg, between 5.6 and 3.8 inches of water evaporated in a month from the soil and during the drier period between 3.7 and 3.2 inches. Mohr proposed to designate as "arid" the tropical climates having mean monthly rainfall of less than 6.0 centimeters (2.4 inches) and as "humid" the climates having rainfall of more than 10.0 centimeters (4.0 inches) a month. Hardy prepared an "effective rainfall map" based on Mohr's scheme and found that only four of Mohr's six regions occur in Trinidad. In these the soil humidity is classed as (1) continuously moist, (2) weak dry season, (3) marked dry season, and (4) strong dry season.

Hardy recognizes that he placed too much reliance on the few evaporation records from Buitenzorg. For example, he points out that in tropical mountains, where temperature is lower, evaporation would be lower also. But there are no experimental data on evaporation from the soil surface in Trinidad. Accordingly, he made an indirect calculation using measurements of evaporation from Livingston white-bulb atmometers. Although these

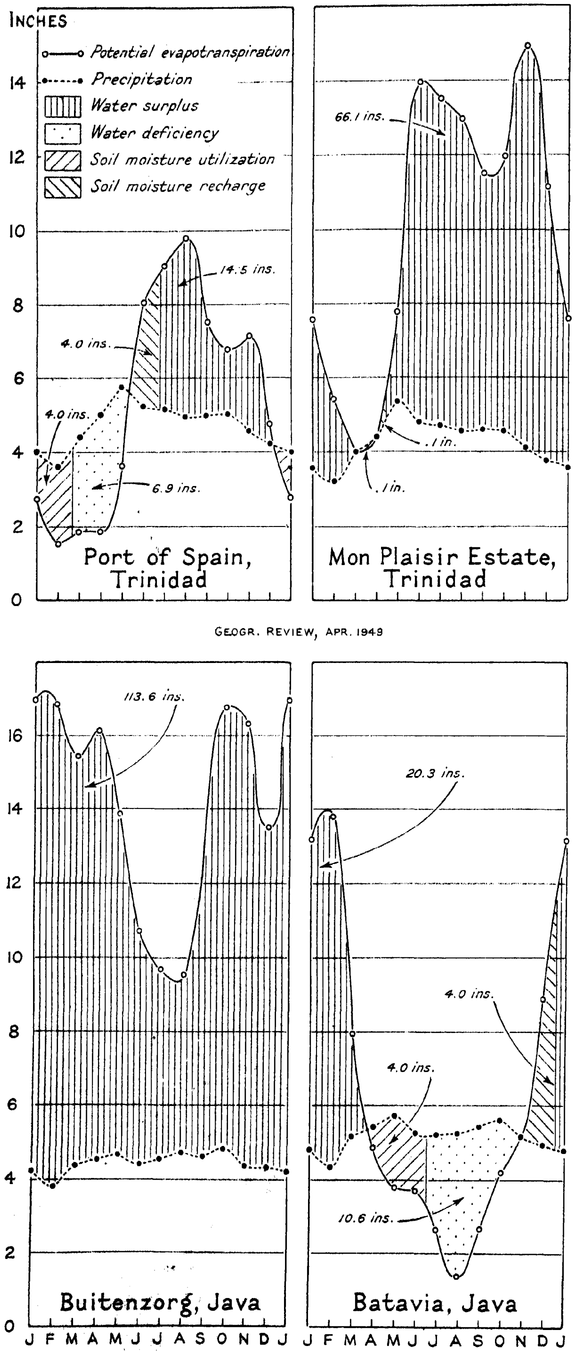

FIG. 1—March of precipitation and potential evapotranspiration at selected tropical stations.

results are highly speculative, he concludes that Mohr's value of 10.0 centimeters (4.0 inches) is correct for Trinidad.

My own formula for determining potential evapotranspiration (*Geog. Rev.*, Vol. 38, 1948, pp. 55–94) was developed through the use of observations made mostly on irrigation projects in the western United States, supplemented by stream-flow and rainfall records from watersheds in the eastern part of the country. I indicated that additional observations are needed, particularly in the tropics and high latitudes, and that until they become available, extrapolation equatorward or poleward will give uncertain results. Still, I have wondered what insight could be obtained into the soil-moisture relations in Java and in Trinidad through the use of my formula. Consequently, I have prepared graphs of the water relations at Buitenzorg and Batavia in Java and at Port-of-Spain and Mon Plaisir Estate in Trinidad. It is interesting to find that the monthly potential evapotranspiration at Buitenzorg is very nearly 10 cm. It ranges from 9.6 cm. in February to a maximum of 12.2 cm. in October. The potential evapotranspiration in Batavia is somewhat more variable and is uniformly higher. It ranges from 10.8 cm. in February to 14.3 cm. in May. The march of potential

evapotranspiration through the year in Trinidad is much more variable. At Port-of-Spain the minimum is in February with 9.1 cm. and the maximum in May with 14.4 cm. At Mon Plaisir Estate the minimum is 8.1 cm. in February and the maximum, 13.4 cm. in May. The mean monthly potential evapotranspiration at Buitenzorg is 11.2 cm., and at Batavia 13.0 cm. At Port-of-Spain it is 11.9 cm., and at Mon Plaisir Estate 10.9 cm. These monthly average values of potential evapotranspiration are all near 10 cm., but they are not 10 cm. The discrepancy presumably means one of two things: either my formula fails in the tropics, or the original evaporation observations that Mohr used were not sufficiently reliable. Potential evapotranspiration reaches its maximum during the dry season, when temperatures are highest, whereas Mohr found that the evaporation from his cylinders was least during the dry period (presumably when there was less water available for evaporation).

I have used the formula in a method to derive soil moisture from daily climatological observations (*Annals Assn. of Amer. Geogrs.*, Vol. 37, 1947, p. 100; *Irrigación en México*, April-May-June, 1946, pp. 39-43). This method could be used in Trinidad. Whether or not it will give reliable results will depend on how accurate the computations of potential evapotranspiration are.

The potential evapotranspiration was determined for an irrigation project devoted to raising sugar cane in Barahona, Dominican Republic, to be 147.3 cm. a year. For Barahona the potential evapotranspiration as computed by my formula is 146.3 cm., a difference of less than 1.0 per cent. Bernard (Étienne Bernard: Le climat écologique de la Cuvette centrale congolaise, Brussels, 1945) estimates the annual potential evapotranspiration in the forest zone of the Belgian Congo to be 165 ± 10 cm. My computations of potential evapotranspiration for stations in the forest area are from 147.2 to 162.7 cm.

The critical need for knowledge of the magnitude of evapotranspiration from the soil in the equatorial latitudes suggests that batteries of evapotranspirometers should be installed in various places. Evapotranspirometers are now operating near Mexico City, at Seabrook, N. J., and in three locations in Ontario (*Trans. Amer. Geophys. Union*, Vol. 27, 1946, pp. 721-723; *Chapingo*, No. 21, May, 1948, pp. 1-8; *Canadian Journ. of Research*, Sect. C, Aug. 26, 1948, pp. 445-454). Wide interest has been aroused in the method, and plans have been formulated to establish stations in Argentina, Israel, Saskatchewan, and on the lower Mackenzie River in the Northwest Territories of Canada. A station in Trinidad at the Imperial College of Tropical Agriculture would yield data of great importance, not only to the island but to the world. It is to be hoped that Mr. Hardy may find means to establish such a station. —C. W. Thornthwaite

CORRELATION OF MARINE TERRACES. In the study of marine terraces correlations may be made from two quite different points of view. If a single region is being considered, an individual terrace or a series of terraces may be dated by correlation with an event or series of events of known geologic age. On the other hand, correlation of individual terraces or of series of terraces in two or more widely separated localities may establish their contemporaneity, though not necessarily their exact age.

Probably the most frequent correlation of the first type is that of a series of terraces with the glacial and interglacial stages of the Pleistocene. Depéret was the first to attempt this, for terraces on the shores of the Mediterranean and of the Atlantic from Morocco to Scandinavia. Similar interpretations have since been suggested for several other parts of the world, among them Patagonia, on which Egidio Feruglio reports in a recent paper (Nueva

contribución al estudio de las terrazas marinas de la Patagonia, *Rev. Soc. Geol. Argentina,* Vol. 2, 1947, pp. 223–238). After establishing the chronological succession of the Patagonian terraces on the basis of elevation above sea level and of associated fossils, Feruglio found that the fossils of successive terraces alternated between those characteristic of colder water and those characteristic of warmer water. The former he correlates with glacial stages, of which four are represented, and the latter with interglacial stages.

Correlations seeking to establish contemporaneity of terraces in widely separated localities are typically associated with studies of eustatic changes of sea level. At first thought it might seem that uniformity of elevation would be a trustworthy indication that terraces resulted from the same eustatic change of sea level and, conversely, that any eustatic change must be recorded by terraces of a given elevation widely distributed over the world. Both Johnson and Daly, among others, have, however, pointed out the falsity of such conclusions and have made it clear that for a variety of reasons, chief of which is differential movement of the earth's crust, features marking the position of sea level at a specific time in the past may differ considerably in their present positions above or below sea level. It is therefore disquieting to find, in a recent summary of marine terraces on the shores of the Pacific (Leo A. Cotton: The Pulse of the Pacific, *Journ. and Proc. Royal Soc. of New South Wales for 1946,* Vol. 80, Sydney, 1947, pp. 41–76), a correlation based entirely on present elevations above sea level and the conclusion that the widespread occurrences of terraces at certain elevations indicate eustatic changes in sea level. Certainly it cannot be expected that in such unstable regions as western North and South America, Japan, and New Zealand, all included in the study, terraces resulting from eustatic changes of sea level in the Pleistocene have been unaffected by earth movements.

Of all the regions discussed in the above paper, Australia, with its long and stable coast, is one of the most suitable for the investigation of eustatism. Although many studies have been carried out there in the past, the first systematic and organized approach to the problem was undertaken in 1946, when the Australian and New Zealand Association for the Advancement of Science appointed a committee on "Eustatic Changes of Sea-Level." "For the correlation of evidence already published, and for the greatest benefit to be derived from material yet to be published, some common plan for presentation of facts is essential," say Rhodes W. Fairbridge and Edmund D. Gill (The Study of Eustatic Changes of Sea-Level, *Australian Journ. of Sci.,* Vol. 10, 1947–1948, pp. 63–67). Accordingly, they discuss the need for a common datum (they recommend mean low-water springs), the types of evidence of eustatic change to be found in Australia, and suggested methods of procedure. Further advice much needed in such a program of investigation is to be found in Douglas Johnson's last summary of the "Problems of Terrace Correlation," published after his death (*Bull. Geol. Soc. of America,* Vol. 55, 1944, pp. 793–818). Here, as in earlier papers, he points out the necessity of precise altitude figures, measured at significant parts of terraces, and the limitations of the method of correlation by altitude. Every student of the problem of correlating marine terraces should keep in mind Johnson's conclusion, that it is "one of the most difficult and delicate of geomorphic operations."—ANASTASIA VAN BURKALOW

OBITUARY

BAILEY WILLIS. The death of Bailey Willis in Palo Alto, Calif., on February 20, 1949, at the age of 91, brought to a close a scientific career nearly seven decades in length. At various times he served the United States Geological Survey as geologist, the Carnegie

Institution as geologist in China, the Argentine Ministry of Public Works as consulting geologist, The Johns Hopkins University and the University of Chicago as lecturer, and Stanford University as professor of geology. In more recent years he carried on independent geologic research in many parts of the world.

"Structural geologist, geomorphologist, seismologist, paleogeographer, explorer of the far-flung regions of the World!" So Adolph Knopf hailed Dr. Willis when, in 1944, he was presented with the Penrose Medal of the Geological Society of America (*Proceedings for 1944*, p. 38). His most outstanding contributions were made in the field of structural and dynamic geology; for example, "The Mechanics of Appalachian Structure" (*U. S. Geol. Survey, 13th Ann. Rept., 1891-92,* Part 2, 1893, pp. 211-281), "A Theory of Continental Structure Applied to North America" (*Bull. Geol. Soc. of America,* Vol. 18, 1907-1908, pp. 389-412), "Research in China" (*Carnegie Instn. Publ. No. 54,* Vols. 1 and 2, 1907), "Geologic Structures" (1923), "Dead Sea Problem" (*Bull. Geol. Soc. of America,* Vol. 39, 1928, pp. 490-542), "East African Plateaus and Rift Valleys" (*Carnegie Instn. Publ. No. 470,* 1936), and, during the last decade, a number of papers on mountain building and seismology. However, geomorphology was also enriched by his observations ("The Northern Appalachians," in "The Physiography of the United States," National Geographic Society, 1896, pp. 169-202; "Research in China," Vol. 1, Chs. 4, 11, and 15; "Physiography of the Cordillera de los Andes," *Compte-Rendu Congr. Géol. Internatl., XIIe Session, Canada, 1913,* Ottawa, 1914, pp. 733-756), and in East Africa, where rock outcrops are scarce, he made much use of geomorphology in working out the geologic structures.

Although Dr. Willis carried on extensive researches in the theoretical aspects of geology, he never lost interest in the practical applications of his work. As a result of his observations, in this country and in China, on deforestation and the resulting problems of soil erosion and valley sedimentation, he became a pioneer in the conservation movement, helping in the struggles to establish Mount Rainier National Park and the United States Forest Service. He continued this work in Argentina, where he aided in developing the plans for the Parque Nacional del Lago Nahuel Huapí and made extensive studies of the economic resources and potentialities of the Patagonian region ("Northern Patagonia," 1914). His seismologic investigations led him to consider the problem of earthquake-resistant buildings, and many of his conclusions have been embodied in California building codes.

In addition to his scientific writings, Dr. Willis published several nontechnical books, of which the best known are probably "Living Africa" (1930) and "A Yanqui in Patagonia" (1947).

Dr. Willis was fond of observing that during his long lifetime many of the geologic concepts he had learned as a student had been proved false and been discarded. His mind was always open to receive new ideas, and he was, to the end of his life, an active participant in the search for scientific truth.—ANASTASIA VAN BURKALOW

GEOGRAPHICAL NEWS

GEOPHYSICAL JOURNALS. The first number of *Tellus: A Quarterly Journal of Geophysics,* published by the Svenska Geofysiska Föreningen, appeared under date of February, 1949. The editor is Professor C.-G. Rossby, now of the Institut för Meteorologi, Stockholms Högskola. *Tellus* is intended to be an international journal for the geophysical sciences. Its editorial language is English, but articles will be in English, French, or German; the first

number, however, is entirely in English. There will also be shorter contributions and announcements, correspondence, and book reviews.

Tellus gets off to a good start with six articles, four of which are concerned with current problems of meteorology. "The Problem of Artificial Control of Rainfall on the Globe," by Tor Bergeron, may be mentioned specifically, at the risk of invidious distinction, as a more broadly based discussion of the induction of precipitation by "seeding" clouds with crystalline carbon dioxide than has appeared in the United States, where the method was invented. The shorter contributions are an announcement by Hans W:son Ahlmann concerning the forthcoming Norwegian-Swedish-British Antarctic Expedition and a report by Anders Ångström on meteorological research in Sweden in the years 1939–1948, with a bibliography.

The content of the quarterly *Terrestrial Magnetism and Atmospheric Electricity* has long embraced a wider range of material than its title suggested. That breadth is now acknowledged by name and by explicit editorial announcement. Beginning with the first number of Volume 54, that of March, 1949, it will be the *Journal of Geophysical Research*. Merle A. Tuve has become editor, succeeding J. A. Fleming. The editorship thus remains in the Carnegie Institution's Department of Terrestrial Magnetism, and under its new name the journal will continue to give special attention to geomagnetic and related phenomena.

From its beginning in 1896, *Terrestrial Magnetism and Atmospheric Electricity* affirmed its international character in a subtitle, and the new title retains that affirmation. The editor invites contributions on the high atmosphere and the ionosphere, on solar and terrestrial relations, and, in addition, on the physics of the solid earth. Emphasis is on theoretical rather than applied geophysics, which is well served by existing periodicals. How wide a circle the journal in its revised form may appeal to is suggested by the inclusion in its first number of an article by Kurt Wegener (now in Buenos Aires) on the measurement of solar radiation and the solar constant. Wegener challenges the accepted value of the solar constant on the ground that the methods commonly used in working up measurements of solar radiation contain a theoretical fallacy.—JOHN LEIGHLY

THE SORCERER'S APPRENTICE: A Journey through East Africa. By ELSPETH HUXLEY. xviii and 366 pp.; map, ills. Chatto & Windus, London, 1948. 18s. 8¾x 5½ inches.

Exhilaration, it has been said, is the test of a drama or other work of art. "The Sorcerer's Apprentice" is exhilarating in its dramatic presentation of an East African journey from February to June, 1947. "Eschewing lions," Mrs. Huxley "talked with clerks—less splendid, but more potent in this turbulent and groping age which is rolling over Africa." She talked with Indians of Nairobi, property owners and traders who have stamped the town with their "banian minds," and with Indians of Dar es Salaam, mistrustful of Nairobi; with a Zanzibari schoolmaster in Lamu and a Hindu doctor, London- and Dublin-trained, in Mombasa; with politicians of the Kenya African Union; with chiefs of the enterprising Chagga coffee growers on the slopes of Kilimanjaro; with a Baganda doctor stationed on the border to examine immigrants from drought-stricken Ruanda; with the Prime Minister of Ankole, worried about cattle lost to the advancing tsetse, and with the Mukama of Bunyoro, who can trace his ancestry back 600 years; with the Prime Minister of Buganda, whose job is the biggest and hardest held by an African in the eastern territories. . . . She talked with D.C.'s and Agricultural Officers, with white settlers, missionaries, teachers, welfare workers. . . . Her swift-moving narrative is a panorama of problems of concern to all interested in "tomorrow's continent."

The exhilaration comes from Mrs. Huxley's ability to sum up a situation in a sentence or two and from the intimacy of her knowledge (she was born in Kenya) that gives life to her words. Thus a reflection at Malindi, where flies the flag of Oman and Zanzibar: "In wealth, in prestige, in vitality, the Arabs have shrivelled. The abolition of slavery wrecked their economy, their land has passed mainly to Indians and their political power wholly to Europeans. They retain their dignity, their customs, their faith and their mastery of the sea." Of the savage and deserted country through which the central railroad of Tanganyika passes: "The mere size of the landscape is something impossible to convey in words, by photography or, I should imagine, even by painting; but then no first-rate painter has tried. The strange hard shapes of the hills, the speckled look of the bush, the huge hidden geometry, need a Cézanne to do them justice." Many other vignettes scattered through the pages give the look and feel of the varied landscape. Yet despite diversity, physical conditions in East Africa as a whole invite erosion, and followers of Osborn and Vogt will find reinforcement of the theses of "Our Plundered Planet," and "Road to Survival." Former deep-grassed veld in Masailand has given way to semidesert. Maize is "tearing the heart" out of North Kavirondo. In Buganda cotton yields are decreasing despite increased acreage. In parts of Sukumaland there are 400 people to the square mile, and even at half this density the land is "being flogged to death." On the Machakos Reserve the government has had to buy grain to feed the Wakamba starving on their overcropped and overpastured land. Wakamba livestock is four times what the land can carry. In former times rinderpest helped keep down the excess; then the white man came in to wipe out disease, charging on the scene "like a blundering rhino horned with desire for good."

Is the groundnut scheme a blunder too? Mrs. Huxley visited one of the projects in central Tanganyika, at Gulwe, a terrain selected from the air. "No one really knows what will emerge from that ocean of thorns: health or sickness, fertility or desert, good soil or

bad. And, most important of all, water or no water. For it is lack of water that has made all this land a wilderness." One hears Clement Gillman speaking. Yet at least one of the managers with whom Mrs. Huxley talked had an ardent faith in the scheme, not simply as a source of much-needed fats but as a transformer of African life.

If some of the desires for good have failed, others are proving successful; the locust and tsetse researches, for instance. At Shinyanga Mrs. Huxley was told that tsetse could be controlled "under certain conditions, and at a certain cost, but we are not satisfied with the answer." Since her visit another forward step has been taken in the production of antrycide (see, for example, *African Affairs,* April, 1949, pp. 149–151), the new drug by which it is hoped to cure trypanosomiasis in cattle. And a great variety of good work is being done at agricultural stations, experimental and educative. Mrs. Huxley instances the two-year course in peasant farming at Bukura, North Kavirondo. But progress is slow; why does not every native who has seen the demonstration hurry back to his shamba and do likewise? Bukura has the dream of an enlightened peasantry; but how can suspicion, apathy, and indolence be conquered—something is missing. What that something is, is the root question. The political aspirations of the educated African alone will not bridge the gulf between dreams and reality. Population presses on the land, creating a dilemma that "leaves all the welfare and all the goodwill in the world powerless and doomed." Is industrialization a solution? The great hydroelectric scheme at Owen Falls, near the point where the White Nile leaves Lake Victoria, is held out as a hope. Education certainly is a crying need. Tanganyika's ten-year plan puts it high on the list, yet "the highest target that can be set is that in ten years' time, fifteen children out of every hundred will receive some schooling." And Mrs. Huxley asks pertinently, what sort of schooling, and where will the teachers come from? She points out that in Makerere at the time of her visit only 20 of 200 students were studying education.

From the ways of the primitive tribesman to the modern world is a terrific leap; can it be accomplished in a generation or two? Can the African grasp the deeper meaning beneath the surface forms of Western civilization; or will his be the fate of the sorcerer's apprentice?

THE GOVERNMENT OF ETHIOPIA. By MARGERY PERHAM. xxiii and 481 pp.; maps, bibliogr., index. Faber & Faber Ltd., London, 1948. 30s. 8¾ x 5½ inches.

For many centuries Ethiopia has been a land of "romantic fascination." Indeed, as Miss Perham writes, a cult of Ethiopianism has developed among the colored peoples of the world, to whom this independent African kingdom has become "a focus of interest and of transferred hopes." Her book will be of great assistance to those who wish to understand both the legends and the facts about Ethiopia today.

The author points out that her task was complicated by the sparsity of accurate written records, and by her lack of personal experience in Ethiopia. During World War II, however, she collaborated with Mr. Frank de Halpert, Dr. Audrey I. Richards, and Dr. Lucy P. Mair on a study of Ethiopia that was privately circulated by the Royal Institute of International Affairs. Although most of her past work had dealt with Britain's African colonies, Miss Perham was encouraged by this wartime experience to undertake the publication of a full study of the Ethiopian government.

Background is provided in a 65-page geographical and historical introduction. The "mountain fortress" of Ethiopia provides a striking example of the influence of geography on the development of a country's institutions and the character of its people. A double

barrier of deserts and mountains isolated and protected the Ethiopians until modern war machines were created, by which time, fortunately for Ethiopian independence, the age of European colonial expansion was on the wane.

The greater part of the book consists of a 200-page analysis of Ethiopian institutions of central government followed by a 100-page description of provincial institutions. Provincial institutions are unusually noteworthy, because the difficult geography of the interior prevented the emperors from consolidating the authority of the imperial government.

Miss Perham devotes a chapter to each of Ethiopia's three most important central institutions, the monarchy, the church, and the army. Constitutionally, church and state are one, and the author believes that Ethiopia's conversion to Christianity in the fourth century was perhaps the greatest influence in its historical evolution. Geography helped the Ethiopian church to withstand attacks from Moslems and other enemies, but the church meanwhile developed a defensive and conservative attitude. To understand prewar Ethiopia, Miss Perham believes, it is necessary to think of "the religious climate of the middle ages when the whole of secular life was infused with religion and when, in complement, religion itself had an earthy flavor." Ethiopian conditions, like those of medieval Spain, "exalted the warrior and the priest."

It is not surprising, then, that with such an environment Ethiopia, though richer in resources, is poorer in health, education, and public services than African colonies under European administration. The brutal Italian conquest produced some revolutionary economic developments. Judged by Britain's colonial record, Miss Perham writes, the amount of capital invested by Italy in Ethiopia is amazing. Although designed to benefit Italians rather than Ethiopians, these changes inevitably had a stimulating effect on a backward economy. After the end of World War II, Emperor Haile Selassié was able to improve Ethiopia's budgetary position, an essential step in preparing the way for modernizing the country.

Miss Perham pays full tribute to Haile Selassié for the tenacity, concentration, and devotion with which he has undertaken the task of reforming and modernizing his country. Although today he does not have to fight "the two classic medieval obstacles to royal power, the church and the nobility," he nonetheless is confronted by the problems of peoples of different races, religions, and historical backgrounds. Centralization of power is needed to solve these problems. Centralization poses a dilemma, however; for it would be dangerous in the hands of a ruler without Haile Selassié's intelligence and good will. Miss Perham concludes that Haile Selassié is Ethiopia's "greatest immediate asset."

"The Government of Ethiopia" is a valuable contribution. The author disarms her readers by suggesting that the book is only provisional and interim in character, and by admitting that her "unconscious British conceptions of government" and her "conscious experience of studying European colonial administration" have undoubtedly influenced her interpretation of Ethiopia. Nevertheless, she has assembled many interesting facts, has made stimulating comparisons and suggestions, and has pointed out subjects needing further investigation, such as the role of the Ethiopian church (p. 101) and the importance of the village chief (p. 276). The book also contains useful appendixes consisting of pertinent documents and a supplementary chapter analyzing Ethiopia's claims to Eritrea and Italian Somaliland.—VERNON McKAY

ADAT LAW IN INDONESIA. By B. TER HAAR. Translated from the Dutch. Edited with an Introduction by E. Adamson Hoebel and A. Arthur Schiller. xiv and 255 pp.; map, bibliogr., indexes. Issued in cooperation with the Southeast Asia Institute. International Secretariat, Institute of Pacific Relations, New York, 1948. $4.00. 8¼ x 5¼ inches.

This is the first book in English that gives a brief but authoritative survey of adat law in Indonesia. The term *adat* is not easy to translate. It is an Arabic word meaning "custom." Snouck Hurgronje, the Dutch Indonesian-Arabic scholar and statesman of the late nineteenth century, used the expression "adat law" for those parts of the adat which have legal consequences, and it has since been generally adopted by Dutch scholars. The term "customary," "native," or "primitive" law indicates the meaning, but each carries connotations that are either misleading or distasteful. The editors of the present volume have therefore wisely decided to retain *adat*.

Bernard ter Haar, a disciple of the great adat scholar C. van Vollenhoven, wrote this book (originally published in 1939) for the use of law students in the Netherlands Indies and could thus assume a certain background knowledge in his prospective readers. Professor Hoebel and Professor Schiller, an anthropologist and a jurist, have greatly increased the value of the English edition by giving the reader in an introduction the ethnological background and the position of adat law in the whole legal system of the Netherlands Indies.

To the geographer the book gives an insight into the social customs of the Indonesians, a people close to the soil and subject to the forces of a tropical environment. The chapters on social organization, land rights, land transactions, and obligations involving land contain fundamental information for anyone who deals with the human geography of this region. This is not to say that there is uniformity throughout the archipelago. Although there is a basic unity of adat concepts (extending north well beyond the political confines of Indonesia), actual forms are widely diverse. Ter Haar's purpose was to formulate a system; his treatment reveals the variety, but it gives no clear picture of the regional patterns. Fortunately, the American editors have added a brief description and a map of the (adat) law-areas, based on Van Vollenhoven's publications. There are nineteen major law-areas (including western New Guinea, which, although politically a part of the Netherlands Indies, actually is not Indonesian at all in its culture). Professor Hoebel remarks: "The law-area is a cultural-geographic unit. Perusal of the map will show that each area is a spacial block. The boundaries of each area were drawn to include culturally homogeneous societies which, although sharing many traits in common with all other Indonesian peoples, possess enough distinctive features of social organization, especially in the field of law, to be set off as uniquely different from the societies of all other areas." He then adds, in language equally familiar to the geographer: "In actuality, the law-area concept of the Dutch adat law scholars is similar in character to the culture-area concept so familiar to American ethnologists. The law-area concept holds the same advantages and pit-falls as the culture-area concept." He warns against the tendency "to center the interest focus of investigators on generalized aspects of native law attributable to the area. It leads to systematized schemologies in which abstraction rather than behavioristic details of actual practice and attitudes in integrated local cultures become the concern of the investigator and writer. The consequence is likely to be a neglect of the functional and behavioristic realities which we in this country have come to feel are so important in social science studies."

This is a sound warning against overemphasizing the regional approach. Regional schemes are means to understanding, not ends in themselves. As such, however, they have great value. The proof of the pudding is in the eating. Professor Hoebel himself points at the voluminous Dutch adat literature as ready evidence that "the law-area concept has been effective as an instrument for the focalizing of Indonesian studies."—JAN O. M. BROEK

HOROWHENUA: Its Maori Place-Names & Their Topographic & Historical Background. By G. LESLIE ADKIN. xiii and 446 pp.; maps, diagrs., ills., index. *Polynesian Soc. Memoir No. 26.* [New Zealand] Department of Internal Affairs, Wellington, 1948. 30s. 10 x 6 inches.

In a chapter of only two pages, "The Territory—Then and Now," a vivid and charming miniature of the historical geography of Horowhenua, succinct yet meaningful, Mr. Adkin laments that if "one of the old-time [Maori] warriors could return to this land of his birth and lifetime, he would find a *terra incognita* strange indeed." In his own words, it is Mr. Adkin's no mean task to record the "ebb and flow of fortune" of the Maori regimes of the past in the Horowhenua, or, more exactly, in the somewhat larger area between the Manawatu River and the pinched-out part of the coast between the mountains and the sea opposite Kapiti Island. But he goes about his job in a rather confused and confusing fashion, for the arrangement is by no means "obvious from a glance." The difficulty is that his original task of methodically recording and mapping place names before they were forgotten has become something much wider in scope and more significant in conception and outcome. Unfortunately, however, the place names (arranged alphabetically) still take more than 300 precious pages, and what many will consider the more valuable part of the work is compressed into less than half that space.

The earlier part of "Horowhenua" makes contributions to several distinctive fields. It contains a praiseworthy discussion of the regional archeology and ethnology of New Zealand and stimulating theories regarding the history and wanderings of the pre-fleet Maoris. Mr. Adkin's conclusion is that the Horowhenua provides archeological evidence (in the form of craniometrical data, triangular adzes, chevroned pendants, and burial practices) of the former presence on the Wellington littoral of the Moa-hunters, the ancient Waitaha people. Students of earliest Maori history will be grateful for Mr. Adkin's patient researches and will look even more eagerly than before for Roger Duff's overdue and long-awaited account of the Moa-hunters of the South Island.

There are at least four other worth-while contributions in the earlier part of the book: a historical account of communications along this coastal strip between the Tararuas and the Tasman Sea, from Maori track to modern highway and railroad; a detailed but incidental description of the physiography and geomorphology, which Mr. Adkin studied in detail before he turned his attention to archeology 20 years ago; miscellaneous factual material of infinite value to the historical geographer; and a series of maps giving not only hundreds of ancient and largely forgotten place names but also an endless amount of topographic detail—Maori *pa* sites, *kainga*, middens, eel weirs, burial grounds, pre-European forest limits and bush clearings, canoe landings, ancient routeways and lines of earliest European communications. It is a pity that further details pertaining to these several fields are hidden in the second part of the book, shut away in the general topographic descriptions

that accompany the explanations of the meaning and origin of hundreds of Maori place names.

Mr. Adkin has given us a book that is most attractive and appropriate in page size, format, and typography, replete with eight plates, 159 sketches and diagrams, and 12 maps. It will become a standard work on the subject.—KENNETH B. CUMBERLAND

THE LIFE AND TIMES OF SIR JULIUS VON HAAST: Explorer, Geologist, Museum Builder. By H. F. VON HAAST. xxii and 1142 pp.; maps, ills., bibliogr., index. Published by the author, Wellington, 1948. £3 3s. 0d. (New Zealand currency). 10 x 6 inches.

A surprisingly large number of German scientists were associated with the developing knowledge of nature in Australasia in the nineteenth century—Dieffenbach, Von Tempsky, Von Müller, Leichhardt, Ulrich, and Von Hochstetter, to name an illustrious few. It was Von Hochstetter, author to-be of the widely read "Neu-Seeland" (Stuttgart, 1863), who met Johann Franz Julius Haast on the day after his arrival in New Zealand in 1858 and persuaded him to exchange his role of agent for German immigrants for that of explorer and scientist. Haast explored, mapped, and named the features of great areas of the mountainous interior of the South Island; the glaciology, paleontology, structural and economic geology, geomorphology, botany, and zoology of the region owe much to his irrepressible energy, industry, and curiosity during the nearly three decades of his life in the young colony. The Royal Geographical Society's award of its Patron's Medal (1884) was only one of many signal honors that accrued to him.

In this long and rambling labor of love, which is the only available biography of the great New Zealand scientist, his oldest son (by his second, New Zealand, marriage) gives us, in utmost detail, the public and private life of an impetuous and restless explorer who was, at the same time, an inquiring and argumentative scientist and an uninhibited participant in public affairs. It was on the physical geography of New Zealand, however, that his broad background and catholic tastes focused his attention. Any student of the life and earth sciences in New Zealand will find in this volume a mine of useful information about the theories and accomplishments of Von Haast and his scientific contemporaries, if he brings to the search much patience and a careful use of the elaborate index. Social historians of the nineteenth-century colony of New Zealand are likewise urged to read this biography. In its telling, dozens of figures briefly appear on the stage, and the political and social, as well as the intellectual, life of early Canterbury is brilliantly illuminated.—ANDREW H. CLARK

NORD-DOBRUDSCHA: Beiträge zur Frage der Beziehungen zwischen Natur und menschlicher Tätigkeit in einer Region der pontischen Waldsteppen und Küstengewässer (Donaudelta) während des 19. und 20. Jahrhunderts. By WERNER KÜNDIG-STEINER. xv and 322 pp.; maps, diagr., ills., bibliogr., index. (Istanbuler Schriften, No. 15.) Aschmann & Scheller AG., Zurich, 1946. 25.80 fr. 9 x 6 inches.

Limited in the north and west by the marshes, sandy islands, and waterlogged surfaces of the Danube (by the Balta lowlands upstream from Brăila and by the delta); limited in the east by the inhospitable coast of the Black Sea, with few good harbors that would facilitate access to this remote corner of the littoral; and adjacent in the south to the steppelike lowlands of northern Bulgaria, the Dobruja is a well-defined geographical region of highly individual character. Geologically it is vastly different from the lowlands of Walachia, the

plateau of Bessarabia, or the folds of the Transylvanian Alps. Its vegetation is of the wooded steppe type, with many subregions that show a transition from the Pannonian to the Pontic; loess predominates among its soils, furnishing an excellent basis for agriculture and building materials; its climate lies halfway between the Central European and that of southern Russia. Its surface is varied; hills 1500 feet high can be found within a short distance of the delta lowlands. Its population until very recently represented a complete cross section of the major racial and linguistic strains present between the double arc of the Transylvanian Alps–Stara Planina and the heights of the Caucasus. The northern part of the Dobruja is the subject of this monograph by Dr. Werner Kündig-Steiner.

Dr. Kündig-Steiner's work is an outstanding contribution to the geographical literature of the Danube lands. He displays an intimate acquaintance with the northern Dobruja and the literature of the region, an acquaintance reflected in his bibliography of 665 entries. As a mirror of the natural and cultural environment of the lower Danube Valley and the coastlands of the Black Sea, this study can serve both as a repertory for the student of the area in its larger aspects and as a model for further monographs. The only conspicuous shortcoming is the paucity of illustrative material, especially detailed maps. De Martonne's map of the Dobruja in the Géographie Universelle series might have been reproduced with considerable profit to readers of the monograph.—GEORGE KISH

MAP OF THE DANUBE-VALLEY AND ADJACENT TERRITORIES. Constructed by GABRIEL BOGNÁR, ANDREW KÉZ, ANDREW RÓNAI, JOSEPH TAKÁCS, FRANCIS TALLIÁN, and GÉZA P. TELEKI. In two sheets (West and East), each 45 x 33 inches. Scale 1 : 1,000,000. Hungarian Geographical Institute Co., Budapest, 1947.

This map, one of the first major products of Central European cartography since World War II, may be described as a new approach to the problem of showing a wide variety of distribution patterns on one map. The area mapped takes in Chemnitz in the north and Sofia in the south, Regensburg in the west and Odessa in the east. The base is orographic: elevations are shown in tints, and contour lines are at 0, 100, 200, 400, 600, 800, 1200, 1600, 2000, and 3000 meters. Major physiographic features and many geographic regions are named. Navigable rivers are indicated by a special symbol; trunk and local railroads, narrow-gauge railroads, superhighways and regular highways, major river ports and seaports, major airfields and broadcasting stations, are shown. Superimposed upon these features is population distribution, shown by dots in a blue-gray tint (census data of 1930), the smallest dot indicating 100 people or fewer. Mineral deposits (iron, manganese, aluminum, chrome, pyrite–copper–gold–silver, magnesite, lead–zinc, uranium, antimony, arsenic, mercury, bismuth, salt, potash, phosphate, graphite) and sources and types of energy (anthracite and bituminous coal, brown coal and lignite, petroleum and natural gas, and hydroelectric power, with size and type of power plant) are indicated by symbols of various shapes, sizes, and colors. The size of the symbols for mineral deposits is proportionate to the output (about 1935): one square centimeter indicates one million metric tons of bituminous coal, or two million metric tons of brown coal, or 500 million cubic meters of natural gas, or 500,000 metric tons of petroleum, or 500,000 tons of iron ore, or 200,000 tons of nonferrous metals, or one million metric tons of salt and other minerals. The boundaries are those of 1914 and 1930.

An interesting feature of the map is the system used for place names. In a marginal note

the authors state: "The denomination of localities on the map is given in the official language of each state territorially determined by the boundaries of 1930. Denominations alive in the language of the nationalities [read "national minorities"—G. K.], or widespread in public consciousness and in literature figure in second line." Thus place names in Transylvania are given in Rumanian, in Hungarian, and often in German; place names in Polish Silesia, in German and Polish; place names in Dalmatia, in Croatian and Italian. Also interesting is the system used in transcribing non-Latin alphabets. Although Russian and Ukrainian names are transcribed with the aid of the official code of the U.S.S.R., Bulgarian names, "for the purpose of a unification of Southern-Slav languages," are transcribed by the Croatian system.

The sources of the map, enumerated in another marginal note, bear witness to a thoroughly catholic attitude. Russian, Italian, Polish, Ukrainian (published in Lvov), Hungarian, Yugoslav, German, Austrian, Rumanian, English (Permanent Committee on Geographical Names), and Czechoslovakian maps, atlases, gazetteers, and statistical and economic publications are among those listed. The map in the reviewer's possession (and that in the American Geographical Society's map collection) has an English title, and all marginal notes and legends are in English; copies in other languages may have been published, though they are not known to the reviewer.

To the student of Central and Southeastern European affairs, "Map of the Danube-Valley and Adjacent Territories" is worth a volume of reference material on physical, economic, human, or political geography. To the student of cartographic techniques, it is an unusual and highly successful experiment in map making. In spite of the vast and almost bewildering array of information, the map, when viewed from a distance, presents a clear picture, emphasizing surface features and population distribution, and printed in a fortunate and pleasing choice of colors. It is a remarkable example of the map maker's art, showing the results that may be obtained by combining cartographic skill and geographic techniques in the selection and representation of distribution patterns. And it is an outstanding achievement of Hungarian geographic and cartographic scholarship.—George Kish

ESSAI SUR L'ÉMIGRATION GRECQUE: Étude démographique, économique et sociale. By Nicos J. Polyzos. 248 pp.; bibliogr. Librairie du Recueil Sirey, Paris, 1947. 10 x 6½ inches.

Few European countries suffered as severely from the war and its aftermath as Greece. Foreign occupation, military intervention, and civil war took a heavy toll of lives, homes, factories, railroads, ports—of almost every conceivable phase of life. It is against this background, and that of considerable American interest in Greek affairs since the end of World War II, that this essay on the economic, demographic, and sociological aspects of Greek emigration should be considered.

Greek immigrants and people of Greek descent can be found in many countries today; more than 380,000 Greeks entered the United States alone between 1900 and 1922. The feudal, backward economy of Greece accounted for a great part of the emigration; the author cites the case of Thessaly, where, during the early years of the twentieth century, three-fourths of the cultivated land belonged to the great landed estates. The precariousness of the Greek economy, brought to the attention of the American public through our assistance rendered since 1945, and especially since 1947, is not a new phenomenon of Greek

life. The collapse of Greek currency and the disorganization of state finances that took place after 1945 were the fifth complete bankruptcy of the Greek state since its liberation from the Turks: similar bankruptcies had been announced in 1827, 1843, 1893, and 1932.

As a result of the Greek-Turkish war and the population exchange that followed it in 1923–1924, more than 1,200,000 refugees from Turkey settled in Greece. The resulting rise in the birth rate lasted until 1935. Since then, the rate has been decreasing, and in 1939 the rate of increase of the total population represented only 10.7/000, as against 16.1/000 in 1934. In view of the ravages of war, both foreign and civil, and the generally decreasing birth rate, Greece seems to be approaching a stagnant period of population change.

The general state of Greek agriculture gives little hope of any early improvement in the living standard of the people. The author bolsters this opinion with some rather impressive figures. As in so many other Eastern European countries, the regime of landed property is characterized by a small number of proprietors controlling large portions of the tillable acreage (29.22 per cent of the arable land is in farms of 61 hectares or more, representing 0.23 per cent of the total number of farmholdings; only 22.5 per cent of the arable land is in farms of less than 3 hectares, representing 72.7 per cent of the farmholdings). Farming methods are primitive (in 1939, 44 per cent of the plows were wooden, and there were only some 1600 tractors in the whole country); and land-use practices are uneconomic (in 1939, 19.5 per cent of the arable land was fallow). Rural financing places an unduly heavy burden on the small and medium holders (in 1940, 93.6 per cent of the rural loans were short-term); there are only a few cooperatives to help the small farmer and the agricultural worker in selling his produce and in purchasing his needs on a more reasonable basis. In a country where fish is a main food, fishing techniques are inadequate (annual average catch per capita before World War II, three kilograms; in Italy, 16 kilograms; in Denmark, 32 kilograms). Hydroelectric power, a major resource, is practically undeveloped; industry, although protected by customs tariffs that are sometimes excessively high, still depends heavily on imports; public-health measures, in a country so badly hit during the last 10 years, are inadequate to cope with such problems as malaria control over large areas.

Although he does not discuss the political aspect of the problem, the author's analysis of the chaotic state of Greece leaves little doubt as to the influence exerted by the political situation on the recovery of his homeland. We should indeed do well to consider problems of Greece in the light of his excellent description of the underlying causes of Greek emigration, past and present, and of his emphasis on the desire of many Greeks to follow the same path in the near future.—GEORGE KISH

SUOMEN LAPPALAISET VUOTEEN 1945 (The Finland Lapps to the Year 1945). By T. I. ITKONEN. Vol. 1, vii and 589 pp.; Vol. 2, 631 pp.; maps, ills., bibliogr., index. Werner Söderström Osakeyhtiö, Porvoo and Helsinki, 1948. 10 x 7 inches. (In Finnish.)

The Lapps of northern Europe have attracted universal interest. Perhaps it is their unswerving devotion to the ways of peace, a quality not always observable among Europeans, that has won them such attention. To quote from the Finnish ethnographer M. A. Castrén's classic description of the Lapp, "Peace is his motto; his first greeting speaks of peace, his farewell is peace—peace is everything to him." Perhaps the appeal has been other unique features of Lappish culture, or was it the relative ease with which these people could be reached and studied? Whatever the reason, the literature on the Lapps has grown to im-

mense proportions since an Uppsala professor, Johannes Schefferus, published in 1673 a pioneering study on "Lapponia." Much of the output has been fictional, some of it of excellent quality, but there is a solid body of scientific research. Regional studies began to appear early. In 1767, K. Leem published a study of the Norwegian Lapps, "Beskrivelse over Finmarkens Lapper"; the Lapps of Sweden were examined by Gustaf von Düben in 1873 in a detailed work, "Om Lappland och Lapparne, företrädesvis de svenske"; and in 1890 an excellent treatment of the Russian Lapps became available, Nikolai Haruzin's "Russkie lopari."

Dr. T. I. Itkonen, who carried out some 12 field investigations during the years 1913–1947, has prepared a truly definitive study of the Finnish Lapps. No aspect of Lappish culture seems to have been omitted from this encyclopedic two-volume work. There are 39 chapters, devoted to such subjects as geographical setting, history, anthropology, language and names, character traits, buildings, trade, fishing, hunting, agriculture, care of deer and dogs, customs and myths, household furnishings, and body ornaments. The bibliography lists nearly 350 titles (of which Itkonen has authored 36), covering the chief Finnish published and archival sources and the significant Norwegian, Swedish, and German monographs. Scholars cannot complain of a paucity of documentation; the chapter on settlement, for example, has on a hasty count no fewer than 246 footnote references. Illustrative materials are abundant: there are 442 well-chosen photographs and drawings and 15 maps.

Itkonen's study of the Finland Lapps has been described in the country of its publication as "one of the most important achievements of recent Finnish scholarship." This is not extravagant praise.

It might be added that Dr. Itkonen is one of the contributors to the fine picture album "Lappi eilen–tänään–huomenna" (Werner Söderström Osakeyhtiö, Porvoo, 1948), which Eila Jokela has edited for the Lapland Provincial Association and Finland Relief. The photographs reveal a "remote, ruggedly beautiful Lapland" as well as the less impressive consequences of war. The captions and accompanying essays are in Finnish, Swedish, and English. The volume is dedicated to the Swedes, Danes, Swiss, English, and Americans who have shared in the difficult tasks of postwar reconstruction in northern Finland—JOHN ILMARI KOLEHMAINEN

EUROPE ON THE MOVE: War and Population Changes, 1917–47. By EUGENE M. KULISCHER. xiv and 377 pp.; maps, bibliogr., index. Columbia University Press, New York, 1948. $5.00. 9½ x 6¼ inches.

"Europe on the Move" was written by a persistent author in the field of population migration whose recognition stems primarily from his wartime book, "The Displacement of Population in Europe," published by the International Labour Office in 1943 (see the *Geogr. Rev.*, Vol. 34, 1944, pp. 502–504) and used with other sources in joint SHAEF/UNRRA pre-D-day planning. A selection of quotations from his conclusions give the flavor of his current volume: "Progressive occupation of Russia's industrial frontier, paralleled by industrialization of other eastern European countries, may [but with the emphasis of *will*] succeed in preventing a dangerous demographico-economic constellation [one not likely to lead to war]." An "overcrowded Germany" (population of 69.5 million, equaling "that of prewar Germany . . . on a soil reduced by 25 percent"), "ready to bear the arms which will be forged by . . . restored industry, . . . may also become a dangerous tool in foreing

hands": this is "the lasting German danger." "Migration is definitely a requisite for expanding world economy, since it directs labor to sources of raw materials and power and to fertile soils in underdeveloped areas." It is the expression of "a trend to equalize the standard of living." "What the world needs is mass migration regulated and promoted in the common interest jointly with a movement of products and of capital. . . . It should balance the demand of people for space to eat their bread, won by the sweat of their brow, against another people's right for protection of their hard-earned standard of living." "Whatever policies a potential immigration country may adopt, the fact that to admit immigration is better than to be obliged to repel invasion should remain uppermost in all minds."

This book may provoke the demographer, but it probably will not stimulate his research efforts. The assertions that "today's demographers tacitly assume that populations grow in accordance with 'normal' birth and death rates, barely touched by . . . legally restricted migrations," and that "the role of cataclysms is minimized" are here matched by an overemphasis of the role of the cataclysm. What was needed was a balanced treatment, for the 30 years portrayed, of birth rate, death rate, and factors of natural increase and their relation to admittedly dramatic variables of migration under conditions of war and its aftermath. What we get, however, certainly by implication at least, is a plea to worship the discredited shibboleth of *Lebensraum* and the suggestion, in view of an unpredictable future, to down tools and await the cataclysm. Perhaps the book suffers most from the author's attempt to cram what should have been a condensed 1000 pages of text into a scant 325. He treats with bewildering assurance highly variable and doubtful statistical sources (especially for the period of World War II), based on military and eyewitness accounts and replete with double counting and omission. He backs his statements with voluminous footnote references and a bibliography of some six hundred entries. One questions the statistics used, the logic of their application, and the conclusions drawn, in spite of the assurance of citations to such authorities, among the many names and agencies listed, as Carr-Saunders, Glass, Kirk, Kuczynski, Lorimer, Notestein, and Simpson.—MALCOLM J. PROUDFOOT

POPULATION ANALYSIS. By T. LYNN SMITH. xiii and 421 pp.; maps, diagrs., bibliogrs., indexes. (McGraw-Hill Publications in Sociology.) McGraw-Hill Book Co., New York, Toronto, London, 1948. $4.50. 9¼ x 6 inches.

Reviewers are prone to criticize an author for the book he might have written instead of evaluating the one before them. In this volume Dr. Smith presents us with perhaps the most up-to-date, scholarly, and careful treatment available of a subject that is "among the most rapidly advancing parts of social science." It is a powerful rebuttal to those who complain of the unscientific, haphazard character of the social sciences. Intended as an advanced undergraduate text, "Population Analysis" actually goes much further. It presents a summary of methods and sources in demography in addition to discussing the known facts about population phenomena. A short section on population size and distribution leads to a painstaking analysis of population composition, and here is found, among other valuable data, what is probably the most comprehensive and satisfying treatment of the demographic significance of occupation and religion yet offered. Part III discusses the vital processes of birth and mortality with no less care. The section that follows, on migration, internal and international, is a refreshing summing up of a difficult topic. The book closes with a chapter on the growth of population.

Many flattering comments suggest themselves after a careful reading of "Population Analysis." One is constantly amazed by the vast amount of work and patience needed to organize the mass of information presented, much of it for the first time in digested form. Dr. Smith has made sense out of a large segment of the unreduced social statistics of the Sixteenth Census. The book is packed with riches; it is a work of compression, and there is scarcely a useless word or needless generalization in it. It is also virtually a demographic atlas, containing 166 carefully drawn figures, the majority of them maps. The maps of racial and religious distributions would in themselves have made publication of the book worth while. On the debit side, Dr. Smith has accomplished a *reductio ad absurdum* in his use of the spherical-symbol method for representing the distribution of total and rural-nonfarm population in the United States. It is unfortunate that he was unaware of, or did not use, the better techniques devised in recent years by geographers and cartographers. An innovation in the graphic representation of population data—the index-number graph—is a welcome contribution. Dr. Smith's healthy skepticism concerning theories on population growth is commendable, and so too his refusal to theorize on any substantial factual grounds. His criticism of the Census Bureau's mode of residence classification follows a line of argument he has long been advancing. It is to be hoped that his positive suggestions will be used in 1950.

Dr. Smith brings into focus several rather startling facts; for example, the remarkably early age of marriage in the United States as compared with other countries and some apparent anomalies in regional differentiations in education in the United States. (How many people realize that the state with the highest median number of years of schooling completed among its urban white population is Mississippi?) In connection with his cogent discussion on internal migration Dr. Smith makes a rare misstatement of fact. Sweden and a few other European countries do have exhaustive statistics on internal migration, and the Sixteenth Census of the United States certainly does not represent "the most ambitious endeavor so far made" in this direction. Among other minor complaints that might be registered is one concerning an insufficient acquaintance with the biology of population, a partial explanation for the confusing treatment given the topic of sex ratios.

An almost total restriction of the discussion to the demographic data of the United States constitutes a serious flaw. This could be accepted if it were the announced intention of the author, but it certainly cannot be agreed that "no effort has been spared to assemble comparable information from other portions of the world." The superior European material, much of it more detailed, and some of it earlier, than the American, is by-passed, and hardly a gesture is made toward using material from colonial lands or Latin America. This is surprising when Dr. Smith's close acquaintance with Brazil is recalled. The book that he might have written would have discussed all parts of the world with the emphasis due them, and it would have encompassed the wider aspects of his subject. This unwritten book would have gone into the historical aspects of population; "Population Analysis" was conceived in a historical vacuum. Above all, it would have had as one of its major themes that central problem of our times, the population-resource balance; Dr. Smith simply denies that the problem exists. It is difficult to consider Monsoon Asia, where nearly half of mankind resides, and certain regions of Latin America and then subscribe to the belief that "mankind is not at the crossroads from the demographic standpoint." Dr. Smith has apparently reacted too violently to the excesses of certain writers, but even the most conservative observer can recognize the frightening symptoms of the impending crisis. In

summary, this ideal text would have been one based not only on the techniques of sociological statistics but also on a broad familiarity with the biology, ecology, history, and geography of population.

As it stands, "Population Analysis" is not the definitive text on demography; but it does treat the demography of the United States in an authoritative and masterly manner.—WILBUR ZELINSKY

CACAO PRODUCTION OF SOUTH AMERICA: Historical Development and Present Geographical Distribution. By IVAR ERNEHOLM. 279 pp.; maps, diagrs., bibliogr. (C. R. Holmqvists Boktryckeri AB., Göteborg, Sweden, 1948. $12.00. 9¼ x 6¾ inches.

When Cortes and his band of *conquistadores* arrived in Montezuma's empire, they found some Indians using both gold and cacao beans as mediums of exchange. They took the gold and left the cacao beans to the Indians. Toward the end of the sixteenth century, when the *Casa de Contratación* and the *Consulado de Sevilla* discovered that they could convert cacao beans into gold in Europe, the Spaniards relieved the Soconusco Indians of their choice cacao as well. So thoroughly did they strip the crop for export that by the beginning of the seventeenth century Central America was obliged to import inferior grades of cacao from Venezuela for its own consumption. South American trade in cacao increased slowly from that time on. In 1900, Ecuador, Brazil, and Venezuela were the primary sources of the world's supply, though their total exports were only about 45,000 tons annually.

In the next three decades the picture changed radically. Chocolate and cocoa, which until 1900 had been luxuries in the United States and Western Europe, had become staples by 1930 as a result of a nearly ninefold increase in production. Negro farmers of the Gold Coast and Nigeria and Brazilian planters in Bahia had entered the picture with amazing success while Ecuadorian production slumped and Venezuelan interest stagnated. Why?

The explanation so far as South America is concerned is part of the task that Mr. Erneholm undertakes in his study. It is a skillful example of how geographical methods may be applied to a tropical-crop problem. Using detailed maps of the main production centers of Brazil, Ecuador, and Venezuela, Mr. Erneholm proceeds to define the particular features of climate, topography, and soils that distinguish these areas. At the same time he considers the matter uppermost in the minds of South American cacao growers—the distribution of the serious diseases, witches'-broom, monilia, and phytophthora. His analysis shows why the areas favorable for cacao cultivation are so limited and why a substantial increase in cacao exports from South America can scarcely be expected, at least until the disease problems are solved.

Plant breeders and pathologists have been at work for some years at the Imperial College of Tropical Agriculture in Trinidad, where cacao is an important economic crop. The writings of Dr. F. J. Pound, who recently met a tragic death in Liberia, are of special interest in connection with the prospects for selecting types of cacao resistant to witches'-broom. The studies of cacao soils by Dr. F. Hardy and associates are also valuable contributions of the Imperial College. Recently cacao research studies have been initiated at the Inter-American Institute of Agricultural Sciences in Costa Rica and at the West African Cacao Research Institute in the Gold Coast.

One of the singular merits of Mr. Erneholm's work is that it measures and maps the cacao problem in South America so well that the plant and soil scientists engaged in various research activities are likely to find it useful in appraising the economic importance of their

work and determining where, specifically, their progress will result in the greatest benefit.

This reviewer cannot refrain from complimenting Mr. Erneholm's Swedish sponsors for their wisdom in financing his work. The United States government has spent millions of dollars in the past decade in cooperating with Latin-American governments on tropical-plant problems, but there still remain to be written the monographs on rubber, cinchona, and other crops that will define their problems as well as Mr. Erneholm has presented the subject of cacao.—EDWARD HIGBEE

THUNDERSTORM RAINFALL. By The Hydrometeorological Section of the U. S. Weather Bureau. Part 1, text, xvii and 331 pp.; Part 2, ix pp. and 155 plates of maps and diagrs. *Hydrometeorological Rept. No. 5.* Waterways Experiment Station, Vicksburg, Miss., 1947. 10½ x 8 inches.

This comprehensive and authoritative study was undertaken at the request of the Corps of Engineers of the United States War Department because of the importance of the thunderstorm or cloudburst type of rainfall in flood-control design.

Chapter 1 is an able and concise discussion of the meteorology of thunderstorms, their structure and dynamics, though much more has since been learned in the government's thunderstorm project started in 1946. Chapter 2 deals with thunderstorm climatology based on records of varying length from more than 200 first-order Weather Bureau stations. The discussion is amply illustrated with annual and monthly maps, charts, and tables. The average number of days with thunderstorms is shown for the whole country, covering the period 1904–1943. The maps of precipitation intensity and areal rainfall are of especial interest to engineers.

The distribution of hail and of tornadoes is compared with the distribution of thunderstorms. No aspect of the subject is neglected. The diurnal variation in frequency for different seasons is considered. More than 50 per cent of summer land thunderstorms occur between noon and 6 p. m. Winter thunderstorms are usually of the frontal type and are more evenly distributed throughout the 24 hours. Over-ocean thunderstorms occur more commonly at night than during the day. The sea surface has a diurnal temperature range of only about 1°F.; the atmosphere 500 to 1000 meters above has a greater range. Instability occurs in the early morning when the air at this level has cooled by radiation. Near the coasts the nocturnal land breeze makes lifting of the cold-front type sufficient to produce thunderstorms, presumably with some aid from radiational cooling aloft.

In Chapter 3 the reliability of areal rainfall determination is discussed. For studying the details of intense thunderstorm rainfall, closely spaced gauges are essential. Improvement in this respect has since been effected in the close networks of the government's thunderstorm observations, in Florida in 1946 and in Ohio in 1947, and radar has been developed as a new tool for measuring rain intensities.

Chapter 4 gives methods of calculating duration-depth-area curves from rainfall data of selected storms. Many graphs and tables of rainfall-thunderstorm relations from different stations are presented. Baguio, P. I., holds the world's record for 24-hour rainfall, 46 inches at the station (July, 1911). In the United States, at Thrall, Tex. (Sept., 1921), 38 inches fell in 24 hours, and the storm was so extensive that in this period 24 inches fell over an area of 1000 square miles. These rains probably represent combinations of thunderstorm with hurricane or general rains.—ELEANOR BROOKS

CULTURAL GEOGRAPHY OF THE MODERN TARASCAN AREA. By ROBERT C. WEST. vi and 77 pp.; maps, diagrs., ills., bibliogr. *Smithsonian Instn., Inst. of Social Anthropol. Publ. No.* 7, 1948. 75 cents. 10¼ x 8 inches.

In a sense Dr. Robert C. West's monograph might be considered a modern *relación* of the battered remnants of the Tarascan people and their gutted lands. The documentary evidence it presents of the Indians' cultural decline and the deterioration of their natural resources is a startling contrast to the poetic picture placards by which the Mexican travel agencies entice the tourist to Lake Pátzcuaro. As one reads Dr. West's account of the logging operations in the mountain pine forests, where "clearing of new plowland to sustain increased population and commercial lumbering have been the major factors of forest depletion," one may wonder what is the purpose of the forest inspectors who, it is said, have been inspecting lumbering activities since 1930.

I stress this point because as I read what Dr. West has to say about the eroded soils on the hillsides about Lake Pátzcuaro, the accelerated deforestation, the lowering of the lake water level, the decreasing fish supply, and the drying up of springs, I kept thinking of the Mexican Secretaría de Recursos Hidráulicos' Comisión del Tepalcatepec. In 1947 the Comisión outlined an ambitious program to "resolve the problems which prevent the development of the valley of the Río Tepalcatepec" (*Ingeniería Hidráulica en México*, Vol. 1, 1947, pp. 145–147), which lies partly within and partly to the south of Dr. West's "modern Tarascan area."

Perhaps this focus of attention on the valley of the Río Tepalcatepec indicates the government's awareness of the problems of overpopulation and declining soil fertility in the Tarascan *tierra fría* and its desire to attract the surplus population into the *tierra templada* and *tierra caliente* of the Río Tepalcatepec basin. Dr. West discusses the government's partly unsuccessful attempt to persuade refugees from the vicinity of the Parícutin volcano to resettle on available lands at lower altitudes in the Río Tepalcatepec watershed. The resulting difficulties, including "increased susceptibility to disease, unfamiliarity with subtropical clay soils, slow adaptation to new crop types," indicate that before the whole Tarascan sierra becomes a submarginal area it might be a wiser and more economical policy to practice conservation measures in that region. Mexico does not have the money, water, or soil to invest in reclamation projects to compensate for the damage poor forestry, grazing, and agricultural practices are now working in such marginal regions as the hills of the modern Tarascan area.

The monograph discusses additional features of Tarascan life and environment: the recession of native speech, changing house types, agricultural systems and crops, and many interesting details about handicraft. These add up to a compendium of facts about a modern people who, one realizes after one has read their story, bear only a tenuous cultural relationship to the ancient Tarascans.—EDWARD HIGBEE

THE JOURNALS OF FRANCIS PARKMAN. Edited by MASON WADE. Vol. 1, xxv and 381 pp.; Vol. 2, vii and 383–718 pp.; maps, ills., index. Harper & Brothers, New York and London, 1947. $10.00. 9½ x 6¼ inches.

To students of historical geography the publication of "The Journals of Francis Parkman" is a welcome event. Especially is this true in view of their competent editing by Mr. Mason Wade, who, incidentally, discovered them in the Parkman home some years ago. For

Francis Parkman was not only the author of the remarkable series "France and England in North America" but also the keeper of diaries—some of them extensive—that embody his observations, or at least his jottings, made during his many trips in North America and in southern Europe and France. More specifically, the journals cover early trips to the White Mountains, Maine, the Lake George and Lake Champlain region, and Canada in 1841, 1842, and 1843; the southern European travels, which lasted from November, 1843, to June of the following year and which carried him to Gibraltar, Malta, Sicily, Italy, Switzerland, France, and Great Britain; the journey into the Berkshires in the summer of 1844; and that into the Old Northwest in the following year. Then in 1846 came his greatest exploit, his Far Western tour. It took him along the Oregon Trail to the foothills of the Rocky Mountains, where he dwelt for some weeks among the Sioux Indians and hunted buffalo, then southward, still east of the mountains, until he struck the Sante Fe Trail, which he and his companies used on their return to civilization, encountering on the way other great wagon trains bringing supplies to Colonel Kearny's dragoons for their Mexican expedition. Although Parkman made other trips, his precarious health would no longer permit the strenuous life of the forties, and it is not surprising that the later journals lack the savor of the earlier ones, interesting though they are to the scholar.

The journals, now in the possession of the Massachusetts Historical Society, together with the 70 volumes of transcripts of original documents that he selected for copying, are impressive evidence of his determination to prepare himself thoroughly to write the story of the early American wilderness. The journals have the defects of their commanding merits. They abound in fascinating descriptions of the country and of the people, civilized as well as uncivilized, with whom Parkman came in contact, but they ignore the great political, economic, and social developments then taking place in North America. In reading them one is left unaware of the growth of American industry, of the creation of new western states, of the spawning of sectionalism before the outbreak of the Civil War, and of the basis of international friction in the Oregon Country and along the Mexican border in 1846.

Nevertheless, the journals are the by-product of the most distinguished American exemplar of the historian who demands as a *sine qua non* a firsthand acquaintance with the local setting of the past events he desires to describe. Indeed, Parkman as a rule considered this a necessary preliminary before undertaking any systematic research. His intense interest in, and his sensitiveness to, the topography of the country—to its mountains, plains, forests, rivers, and lakes—represented, however, the reaction of a poet rather than that of a student of geography; nor did he find in geography a science that would provide a key to the solution of many types of historical problems. Superior as he was to all his contemporaries in the field of history, including Bancroft, Prescott, and even Henry Adams, and possessed of great intellectual integrity, he was still a product of his day and age, sharing most of its prejudices and adding a few of his own as one of America's elite reared in the midst of a group of highly exclusive and distinguished Boston aristocrats. His harsh judgments—freely recorded in the pages of his journals—of less favored people culturally with whom he came in contact show how little he grasped the deeper meaning of the phenomenon of American civilization to be described later as "the melting pot." Yet it would be unfair to him not to point out that he extended his friendship to many people, from scholars to uncivilized natives.

The intimate relationship between the journals and the books that came from Parkman's pen is nowhere more clearly indicated than in his most popular work, which appeared in

1849—"The Oregon Trail." This, as Mr. Wade points out, is based almost entirely on the journal of 1846. His first purely historical work, published in 1851 and repeatedly revised, is "The Conspiracy of Pontiac," actually the least successful of his books. It was not until 14 years later that there came the first of his great series which was published between 1865 and 1892 under the general title of "France and England in North America." In these volumes we find Parkman the mature scholar and restrained stylist who again draws heavily on his journals to give color and life to his unforgettable descriptions of the land and the people.

Whatever adverse reflections are made on the work of Francis Parkman, one may still affirm that he is regarded, and fairly so, as America's greatest historian. It is fitting that his journals should have been made available for the use not only of the general reader but of the scholar as well. Mr. Wade had already shown himself eminently well equipped to assume the exacting responsibility of editing them, as the author of "Francis Parkman: Heroic Historian" (1942), a book exhibiting a fine sense of proportion and discrimination. —LAWRENCE HENRY GIPSON

NEW COMPASS OF THE WORLD: A Symposium on Political Geography. Editors: HANS W. WEIGERT, VILHJALMUR STEFANSSON, and RICHARD EDES HARRISON. xix and 375 pp.; maps, diagrs., bibliogrs., index. The Macmillan Co., New York, 1949. $5.50. 8½ x 5½ inches.

Here is a book on a subject of great timeliness. Few can disagree with the thought behind the title—that in this present period of armistice the world has acquired a new look, that classic methods of studying global space relationships have been outmoded, and that we must speedily attempt to adjust ourselves to facts which seemed wild imaginings not too long ago.

The reader who searches for ready-made answers to many of the most urgent problems confronting us will no doubt be disappointed. In refreshing contrast with numerous other postwar products, the editors have refrained from presenting blueprints of the future or sure-fire solutions. As is proper in a "symposium," nearly every contribution states a problem, sets forth the salient facts, and raises questions as to how the problem may or might be solved. This is, then, a notably provocative book, and it would be an admirable guide for the use of working seminars and students willing to set their research sights on the uncertain future.

It is no doubt unfair to select any few papers from a symposium to which many distinguished participants have contributed and assert that this personal selection represents the most stimulating work. However, as a student of world politics who must needs draw on history, geography, sociology, and political science in any attempt at understanding, this reviewer finds that those chapters which deal with broad, global problems of "geostrategy" are the most worthy of careful attention. The paper by Dr. Weigert on "Strategic Bases" is especially thought-provoking, as is his other paper, "Heartland Revisited." If we accept the existence of a global conflict pattern between the United States and the U.S.S.R., it is surely a basic necessity to rethink Mackinder's concepts in terms of technological change. The view of basic world conflict as between land and sea power has, rather obviously, been modified from the air. If it is true, as Weigert states with admirable conciseness, that the American frontiers of national security "lie wherever American interests are at stake, and

. . . reach anywhere that peace is endangered," *then, indeed, a thorough revamping of* American strategy, both military and political, is imperative.

To this reviewer, these two papers are the pivot of the book, and all else should have been centered around them, in an arrangement emphasizing the basic questions more sharply. Stefansson and others provide an entire chapter on the Arctic and Antarctic in relation to global Great Power strategies. There is much here that is instructive and worthy of further study, though some sweeping assertions, such as Watson's statement that the Arctic "may become to the future what the Mediterranean was to the past," still seem a bit farfetched. On Europe, and Soviet Russia's relationship to it, C. B. Fawcett and Robert Strausz-Hupé contribute especially valuable papers, relating the "Heartland" to the human and material resources of Europe and analyzing the significance of Russia's new western boundaries.

The chapter on Asia is somewhat more prosaic than those on Europe and the U.S.S.R., but Owen Lattimore's scholarly study of "Inner Asian Frontiers" is informative in the extreme, and the papers on demographic problems of the region, including Southeast Asia and Japan, sharply pose the population question once more.

Three major regrets must be registered. It seems highly unfortunate, though perhaps inevitable, that the majority of the papers appear to have been finished about the end of 1947, though the book itself was published in 1949. Certain of the papers suffer from the evident lack of relation to the swiftly moving current of events. Dr. Cressey's treatment of "China's Prospects," for example, makes strange reading today. Several papers would have been greatly improved by visual aids, including some of Mr. Harrison's maps. And it is probable that many potential student readers would have benefited from an editorial concluding section which might have brought the whole into comprehensible focus. Finally, it may be hoped that the later editions richly deserved by the book will receive more careful proofreading than is evident in the first.—WILLIAM G. FLETCHER

VILLES CONGOLAISES: Étude de géographie urbaine et sociale. By JEAN DRESCH. Maps, ills. *Rev. de Géogr. Humaine et d'Ethnol.*, Vol. 1, No. 3, 1948, pp. 3–24.

In connection with Dr. Pendleton's report on his visit to the Belgian Congo, attention is called to this description of fast-developing urbanism in the colony and its French neighbor. M. Dresch classifies the towns as white and black, with the towns of the blacks further distinguished as *villages* (French Equatorial Africa) or *centres extra-coutumiers* (Belgian Congo) and *camps*. The former are native agglomerations having their own administrative systems, though the white authorities choose the administrators and judges and exercise a severe control, especially in matters pertaining to policing and hygiene; regimentation is less strict in the French colony. Léopoldville has two *centres extra-coutumiers;* Brazzaville has two *villages*. In 1947 a million and a half natives lived in *centres extra-coutumiers*. The *camps* are occupied by workers living under a paternalistic regime; they are sources of labor, dormitories in fact; and they are notably developed in the mining regions. Peculiar though they are, M. Dresch calls them true towns because all ties with rural life have been severed.

The article includes plans and photographs of Pointe Noire, port and terminus of the Congo-Océan railroad and a future industrial center; the old river towns of Bangui and Brazzaville; Léopoldville, Elizabethville, and the copper-uranium town of Jadotville-Panda near Kambove.

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Ubique: A Challenge

"UBIQUE" is a proud word, and the Society takes pride in a near-century's endeavor to live up to the challenge of its motto. Our founders declared their object to be the advancement of geography "by the collection and diffusion of [geographical] knowledge"; they planned "a collection of the most valuable maps and books of reference . . . from all countries" and meetings, open to the public, for the reading of papers "collected from all quarters." Foreign consuls resident in New York City were ex officio members of the Society, and it was hoped to obtain through their assistance "the latest, completest, and most authentic information, publications, and public documents, from their respective countries." The aid of missionaries—Livingstone was one—was to be enlisted. The explorations conducted by the Army—the great western surveys—and the Navy—from the Arctic to the tropics—were to be drawn on. At the first public "sitting" of the Society, in January, 1852, a "Memoir on the Geography, History, Productions, and Trade of Paraguay" was read by the United States consul to that country. At the second sitting the President, the eminent George Bancroft, dwelt on the reasons for the founding of the Society and its locale. New York City had "attained to a distinction in the world such as no city ever attained . . . in so short a period. . . . The commerce of this one port, New York, to-day, is greater, vastly greater than was all the commerce of Great Britain at the time when Cook was sent out to make his discoveries in the Pacific Ocean." Such a position, he said, entailed responsibilities, an obligation "to concentrate that information which is obtained from so many quarters respecting our globe"; and along with this went a "deep interest . . . in the spiritual welfare of every nation of mankind."

The ubiquitous interests of the young Society were expressed in the Annual Address for 1854, delivered by that "pathfinder of the seas" Matthew Fontaine Maury. In his review of recent progress in geography Lieutenant Maury, as he then was, spoke of the Northwest Passage and McClure's achievement; Lieutenant Herndon's Amazon expedition and Lieutenant

Page's Río de La Plata expedition; Gilliss' astronomical mission to Chile and the journey of his associate McRae across the Argentine pampas; the American Nautical Almanac; the project of a ship canal across the Isthmus of Darien; Commodore Perry's survey of Jeddo harbor and Commander Ringgold's surveys in the North Pacific; deep-sea soundings between Newfoundland and Ireland, exploratory to the laying of a submarine telegraph; work of the Coast Survey, the Hydrographic Survey of the Great Lakes, and the Mexican Boundary Commission and railroad surveys in the West. If the stress was mainly on exploration, applications to research were anticipated. The Amazon expedition early aroused hopes for great development in the Basin, the capacities of which to sustain population "are thought to be the greatest in the world." The Maritime Conference at Brussels, held by invitation of the United States, proposed "to convert every well appointed ship . . . into a floating observatory, and to unite the whole sea-faring world into one general system of physical research." Maury waxed eloquent on the prospect: "I cannot find terms too strong to express my ideas as to the sublime spectacle which the world is about to afford, touching this united effort to investigate the laws which control the winds and currents of the sea." He urged the universality of scientific research, its protagonists "all fellow-citizens alike of the great Republic of Science."

In June, 1854, Henry V. Poor, railroad expert and one of our founders, read a paper on a proposed transcontinental railroad. He referred his audience to the "magnificent" map, "one of the first labors of our infant society," which, "though unfinished, is by far the most complete of the kind yet executed of the western portion of the territory of the United States . . . The construction of such a map was a proper initiative for a society like our own." The thought behind this early cartographic undertaking is identical with that behind the "Millionth Map of Hispanic America"—"the most important step toward accurate geographical ideas, is an intelligible and authentic map."

The Society has had associated with it a large number of men distinguished in public life and earnest in devotion to its ideal. Such a one was Judge Daly, who during his presidency (1864–1899) delivered a famous series of annual addresses on the geographical work of the world. In his address for 1873 he referred to geographical societies and their function; they have "impressed upon the age the importance of exploring the unknown regions of the earth, and of obtaining more accurate and scientific knowledge of the parts that are known,—as a means alike of bringing about a more extended intercourse amongst mankind, and of enlarging our knowledge of

those great physical laws, as yet but imperfectly understood, which affect the earth and everything existing upon it."

The influence of a geographical society is exerted in part through its publications. In 1852 our Society began publication of a bulletin. Since that time the character of our magazine has undergone many changes, but the original objective has never been lost sight of. Introducing the first number of the *Geographical Review* (1916), successor to the *Bulletin of the American Geographical Society*, Isaiah Bowman said: "It is the essence of the modern idea that knowledge is of value only when transformed into action that tends to realize the aspirations of humanity. It is precisely this view that the Society has always taken. . . . We shall therefore hold steadfastly to our founders' aims to enrich the intellectual life of our time and to serve its idealistic purposes no less than its practical ends." In the prosecution of these aims the Society is advantaged because it is a free and independent organization, as our President pointed out recently (Vol. 38, 1948, p. 177). This was Judge Daly's conception—"the facts, and nothing but facts, as the firm basis for true scientific knowledge, were what he sought, and he believed that they could be best accumulated through the agency of such an association as ours."

The situation today is different only in intensity, not in kind; the challenge of Ubique is greater than ever before. Our founders would surely be filled with delight, tempered perhaps with a slight dismay, could they see the collection of maps and books now grown out of bounds and the deluge of papers received "from all quarters." The distribution of the *Geographical Review* is world-wide; its contributors and their contributions have a like ubiquity. One of the main problems of the editor is that of selection. The editorial, a feature introduced in January, 1948, is designed to illuminate the ideas underlying the selection of material for publication.

With this number the *Review* has a new editor, Wilma Belden Fairchild. Mrs. Fairchild has been on the staff of the Society for eleven years; she is conversant with the work of all its departments; she will welcome the manuscripts that come into the editorial office in all their wide range and variety and make "one little roome an everywhere."

GLADYS M. WRIGLEY

Water—The "Noblest Element"

"With earth's waters make accord" is an adjuration we may well heed in all its implications. And how varied and far-reaching these implications are! In this one number of the *Geographical Review* we touch upon such water aspects as fish resources, hydroelectric and reclamation schemes, irrigation and conservation, rivers as ways of communication and rivers as cultural and political boundaries. Each has in turn its own ramifying relationships. Peter Scott, whose interest in South African fisheries is exemplified in the article on otter-trawl fisheries, writes that his main concern has been with the provision of protein foods to the native peoples. "This surely has fundamental significance. The declining productivity of the Transkeian Territories demands more than the provision of hospital services. To observe the eroded pastures, the poor condition of the cattle, the diseased and underfed natives, is to feel a burning desire to find solutions to the problem of a declining supply of animal proteins. The situation is grave, and here the fisheries can come to the fore. Last year was one of phenomenal increase in production." Mr. Scott's preoccupation with this problem grew out of his two years and a half of service in South Africa as a pilot in the Royal Air Force, during which time he viewed "almost every square mile of the Union" from the air. Subsequent travel on the ground provided fresh experience, and "always the same problems presented themselves—the need for field investigation into factors affecting native settlement, for an accurate assessment of potential resources and actual utilisation, for conservation, always for detailed field work."

Earth's Waters

A supply of hydroelectric power for mines and mills and, secondarily, of water for irrigation is the incentive behind the project for damming the upper Zambezi River at the Kariba gorge. According to the engineer who carried out the preliminary survey of the site, the lake impounded by the dam "would make the Boulder Dam look like a fishpond" and "would probably hold more water than America's four largest dams put together." John H. Wellington discusses the hydrographic relationships underlying this and other developments, including a proposed project on the Okovango. Professor Wellington had expected to continue work on the Okovango studies, but he now writes that "The High Commissioner appears to be very much occupied with this troublesome Bechuanaland chieftainship discussion, and our proposed visit to the delta seems to be indefinitely postponed."

Power and Irrigation

Somewhat farther north another power and irrigation project, likewise of considerable magnitude, has been approved by the governments of Egypt and Uganda and will shortly be under way. This is the construction of a dam at Owen Falls on Lake Victoria, which will, among other envisioned benefits, aid in the regulation of the headwaters of the Nile—a matter of vital importance to Egyptian agriculture. Writing on the pressure of population on the land in Egypt, Douglas Crary has stressed that "the only means whereby the demand for greater agricultural production may be met lies in a more intensive use of the available land, which in turn depends upon a more effective utilization of the waters of the Nile. In these terms . . . Egypt is fighting for its very life" (*Middle East Journ.*, July, 1949). His field study of a single village, Zeiniya Bahari, illustrates in microcosm the broad problems of irrigation and land use in the Nile Valley. The article derives from observations made in the course of a 10,000-mile journey—largely by pickup truck—through parts of Egypt, Saudi Arabia, Iraq, Iran, and Turkey in 1948.

Rivers in History

The role of rivers as ways of communication and of river valleys in the determination of transmontane routes is touched upon in Herold Wiens's article on the Shu Tao, the Road to Szechwan, and here again there is a further implication. In the long history of China the great rivers have dominated the transportation story, and the poorness of land communication has impeded economic and cultural progress; thus the few historic land routes that exist gain in significance.

Rivers have also played an important part as political and cultural boundaries, as Werner J. Cahnman's historical summary of frontiers between East and West in Europe makes abundantly clear. The Rhine and the Danube have long been classic exponents of the dual function; not so well known, perhaps, is the role of lesser streams such as the Elbe, the Saale, and the Oder. Dr. Cahnman's article provides a background for the understanding of present-day happenings in Europe. "Europe was born, as it were, with the scars of division across her face. More than once these scars have seemed to heal, only to reappear, so that in retrospect a pattern emerges which, if understood, could be a guide for future action."

An unusual feature of economy in the Gambia results from the advantages of cheap transportation on the Gambia River. Migrant or "strange" farmers come into the country from neighboring territory for the express purpose of raising groundnuts—a matter chiefly of its being "cheaper for the farmer to

move himself than to pay for the transport of his produce from the remote hinterland." H. Reginald Jarrett tells us something about these seasonal migrants and their part in the production of groundnuts, the Gambia's principal source of cash income.

Water as a Resource

One of the most urgent and complex aspects of the need to "make accord" with water resources lies in the field of conservation. Here the ramifications are almost endless. Such major features as reclamation, flood control, and beach protection come readily to mind, but the more specialized phases are less easily recognized. Gilbert F. White calls attention to some of these in his discussion of recent conservation literature, and more particularly of papers presented at the United Nations Scientific Conference on the Conservation and Utilization of Resources. Among them are the re-use of water from sewage-disposal plants, proper drainage to prevent excess salinity on the land, control of reservoir silting, and the supplementing of farm food supplies by the cultivation of warm-water fish in ponds.

A Pioneer Settlement

Ushuaia, the southernmost town in the world, used to be reachable with comparative ease only by water; now commercial air service has brought it within the realm of feasibility for interested travelers. In November of last year Charles B. Hitchcock made the trip by plane at the close of the Fourth Consultation on Cartography of the Pan American Institute of Geography and History, held in Buenos Aires. His visit to Ushuaia coincided with the establishment there of the new Italian settlement of Empresa Borsari. The resulting firsthand observations afford an unusual opportunity to follow the development of a modern experimental colony from its inception, and the accompanying photographs provide a useful record of the early stages. In a recent letter to Mr. Hitchcock (August 22), an Italian scientist connected with the settlement indicates progress and remarks that "our life here is always the same, and the most important problem for us is how to spend time in holidays!"

In analyzing the natural diversity of Korea, Shannon McCune emphasizes the economic disabilities created by the 38th parallel. "Originating as a hasty military expedient and functioning as a rigid barrier despite its handicaps as a natural boundary," the parallel is of critical interest in current Korean developments.

W. B. F.

OTTER-TRAWL FISHERIES OF SOUTH AFRICA*

PETER SCOTT

THE South African otter-trawl fisheries, which provide most of the fresh fish consumed in the Union and the High Commission Territories, are particularly important, not only because of the severe limitations imposed on the Union's agricultural production by natural factors but because of the contribution the industry can make toward balancing the native diet in South Africa. Of the total catch for 1948, which yielded 83.5 million pounds of fish valued at £848,900, no less than 84 per cent both by weight and by value consisted of two species, the stockfish (*Merluccius capensis*), which alone furnished 79 per cent by weight though only 68 per cent by value, and the Agulhas sole (*Austroglossus pectoralis*), which furnished only 5 per cent by weight but 16 per cent by value.[1] The concentration of stockfish in large quantities off the west coast together with the occurrence of the valuable mud sole on the Agulhas Bank has given rise to regional fisheries localized by well-defined trawling grounds and centered on four ports.

Oceanographic and Biological Conditions

The otter-trawl fisheries are located mainly on the continental shelf but in places extend to a depth of 300 fathoms on the continental slope. Along the whole coast line of 1560 miles the continental shelf, except for the Agulhas Bank, is not wide. If we assume that the shelf extends to a depth of 100 fathoms (in places, for example south of Algoa Bay, the limit would seem to be somewhat less), it averages about 15 nautical miles in width along the Natal coast. Farther south the shelf increases gradually to about 25 miles off Cape St. Francis, then broadens rapidly as the Agulhas Bank is approached. West of Knysna, which may be regarded as the eastern limit of the bank,[2] the 100-fathom contour reaches a maximum distance offshore of 120 miles. From Cape Agulhas to Cape Point the distance decreases from 43 miles to less than 7 miles. Along the west coast, except for a sudden

*The writer's thanks are due to Dr. J. M. Marchand, assistant director, Fisheries and Marine Biological Survey of South Africa, for his interest and help.

[1] Statistics for this article were compiled from the monthly returns of the trawling companies to the Division of Fisheries.

[2] W. E. Isaac: South African Coastal Waters in Relation to Ocean Currents, *Geogr. Rev.*, Vol. 27, 1937, pp. 651–664; reference on p. 651. This paper examines irregularities in the temperature gradients and reviews data published before 1937 relating to the chemistry of South African coastal waters.

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broadening off the Orange River mouth, the shelf width ranges from 12 to 40 miles. From Cape Point to Saldanha Bay the 300-fathom contour, which represents the extreme limit of commercial trawling along this section of the coast, is 30 to 65 miles offshore. From Cape St. Francis to Port Alfred, the only other section where deep-sea trawling is important, the distance ranges from 25 to 32 miles. Trawling beyond the 300-fathom line would demand a larger winch and a longer warp than those at present in commercial use.

The warm Agulhas Current, derived from a confluence of the Mozambique Current and a branch of the South Equatorial Current in the region of Delagoa Bay, flows southward and westward at 1.5 to 4 knots along the Indian Ocean seaboard. Trawlers returning to Capetown normally keep well out to sea to take advantage of the main current, which flows several miles offshore, whereas those traveling eastward hug the shore to avail themselves of the countercurrents. There is, in general, a decrease in the mean annual surface sea temperatures from Durban to False Bay. On reaching the Agulhas Bank the current divides into three branches.[3] The main stream is deflected southward and then eastward to become the Agulhas Return Current. A second branch flows westward as a surface current and merges into the Atlantic water masses. The third and northern branch rounds Cape Agulhas, follows the coast at some distance offshore, and finally becomes indistinguishable through mixing north of Saldanha Bay.

Between this northern branch and the coast, upwelling cold waters, derived from a mixing of Antarctic, sub-Antarctic, and subtropical waters, appear at the surface.[4] From Cape Point to Saldanha Bay temperatures and salinities are lower inshore than 80 nautical miles offshore,[5] markedly so in summer. In summer the difference is seldom less than 10° C. in temperature and 0.6 per mille in salinity, whereas in winter it rarely exceeds 3° C. and 0.2 per mille. These seasonal variations are due mainly to two factors that facilitate a larger upwelling of cold water in summer than in winter: the greater speed of the Agulhas Current in summer; and the prevailing southeasterly coastal winds (in winter the prevailing winds are northwesterly), which drive the inshore waters away from the coast. An occasional surge in the flow of the Agulhas Current, resulting in an increased upwelling of cold

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[3] C. von Bonde: The Division of Fisheries: Sixteenth Annual Report for the Year Ended December, 1938, *Official Journ. Dept. of Commerce and Industries*, Vol. 2, No. 3, Pretoria, 1939, pp. 134–168; reference on p. 134.

[4] G. E. R. Deacon: The Hydrology of the Southern Ocean (Discovery Reports, Vol. 15, pp. 1–124), University Press, Cambridge, England, 1937.

[5] Von Bonde, *op. cit.*, pp. 134–135.

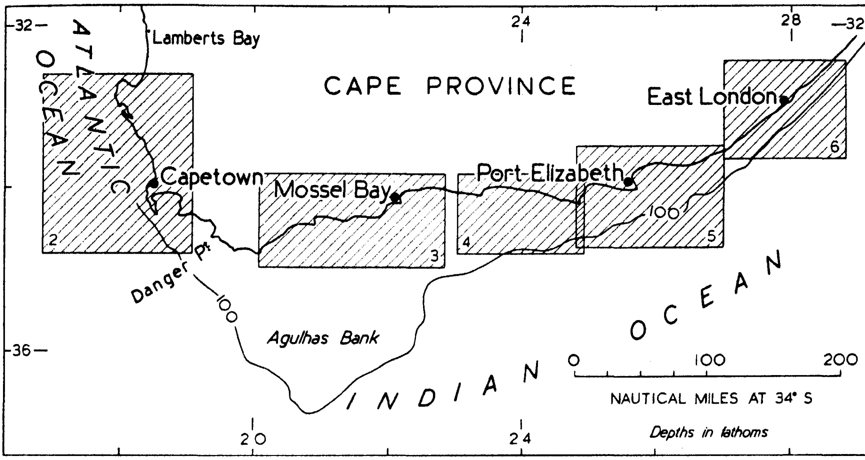

FIG. 1—Location map for Figs. 2–6. One-hundred-fathom contour from British Admiralty Chart No. 2095.

water and a sudden change in temperature, salinity, and associated conditions, has probably been the cause of the mass fish mortality that sometimes occurs along the west coast.[6]

The distribution of plankton in the coastal waters is profoundly influenced by the contrasting conditions of temperature and chemical composition of the Agulhas and Benguela Currents. The mean annual sea temperature at Walvis Bay is almost 6° C. lower than at Durban, even though Walvis Bay is 7° of latitude farther north.[7] Moreover, the Benguela Current contains less salt than the surrounding waters but a higher proportion of phosphates and nitrates and thus supports an abundance of plankton. This accounts for the characteristic green or brown color of the west-coast waters and the clear blue color of the warmer seas. Occasionally in summer the surface of Table Bay is colored red by an enormous concentration of the phosphorescent *Noctiluca,* which, by fouling the water, apparently results in suffocation of both plankton and fish. The occurrence of "dark water" off the west coast, due to an accumulation of diatoms, normally promises good catches for inshore fishermen, though "green water," with results comparable to those of "red water," may be caused by too great a concentration of diatoms.[8]

The favorable feeding grounds off the west coast furnish greater quanti-

[6] See "Upwelling Water, Fish Mortality, and Petroleum" by J. C. Armstrong elsewhere in this number of the *Geographical Review.*—EDIT. NOTE.

[7] Isaac, *op. cit.,* p. 656.

[8] J. D. F. Gilchrist: An Enquiry into Fluctuations in Fish Supply on the South African Coast, *Province of the Cape of Good Hope Marine Biological Rept. No. 11, for the Year Ending 30th June, 1914,* Capetown, 1914, pp. 8–35; reference on pp. 17–19.

ties of fish, but fewer species, than the east-coast waters. Stockfish, kingklip, maasbanker, jacopever, John Dory, and the so-called "supersole" are the only trawl fish caught in commercial quantities from Walvis Bay to Cape Point, but together they make up more than 80 per cent by weight of the total annual landings. The remainder of the catch comprises numerous varieties, each of which is caught only in small quantity, obtained in the warmer waters; they include Agulhas sole, panga, gurnard, silverfish, red and white stumpnose, red steenbras, angelfish, and geelbek.

Variations in the complicated system of surface currents probably account for the presence of certain species in the waters of both the east and the west coasts. Moreover, the sea is less influenced by currents at depth than it is near the surface, so that relatively deep-water fish, such as stockfish and kingklip, are caught in payable quantities as far east as Algoa Bay. White stumpnose, which yields good catches on the shallow-water grounds between Cape Agulhas and East London, is typical of species distributed throughout South African coastal waters in that it occurs in greater abundance off the west coast than off the south and east coasts.

The Catch

Since 1935, when landings amounted to 27.7 million pounds, the catch has trebled in quantity (Fig. 7). Production in 1948 exceeded that in 1947 by 25 million pounds, by far the largest annual increase in the history of South African trawling. For the last 20 years the mainstay of the otter-trawl fisheries has been the stockfish or Cape hake, a cold-water species closely related to the European hake. Its distribution from Walvis Bay to Natal, despite a marked concentration off the west coast, reveals a comparatively wide range of temperature tolerance. Trawling is done during daylight, because at night stockfish leave the bottom, where they have been lying all day, and search for food in midwater or near the surface. In 1948 the catch reached 65.6 million pounds, valued at £574,200.

Notwithstanding the economic importance of the stockfish, no detailed study of its life history has yet been made. Fish less than 11 inches long are seldom caught in the trawls, so that the stockfish probably resembles the European hake in being pelagic during the first two years of its life.[9] Mature fish may reach 40 inches in length. They spawn close inshore, presumably in water shallower than the trawling grounds, between September and January. During the next three months they begin their seaward migration

[9] C. F. Hickling: The Hake and the Hake Fishery, London, 1935.

across the fishing grounds to the deeper waters beyond. Late in winter, usually in September, when the grounds have become relatively depopulated, the landward migration back across the grounds begins. Seasonal fluctuations in catches correspond with these migrations. The months of maximum and minimum productivity on the trawling grounds vary from year to year and from one section of the coastal waters to another, but, broadly speaking, productivity reaches the maximum between March and June, falls to the minimum in September, and then rises to a secondary peak in November or December. Catches for January and February appear to be slightly below average.

Included in the figure for stockfish landings are 2.7 million pounds of livers, valued at £56,000 for their vitamin-oil content. The maximum percentage of oil is obtained from the livers between April and June and the minimum in October and November. The vitamin A potency, however, varies inversely with the oil content, reaching its maximum in October and November. The variations are thus related to the sexual cycle of the stockfish, the fat content beginning to decline and the vitamin A content to increase when the spawning season begins.[10]

Second in importance is the sole fishery. The 1948 catch, though weighing only four million pounds, was valued as high as £135,000. Unfortunately, statistics do not discriminate between the Agulhas mud sole and the inferior supersole (*Austroglossus microlepis*) caught off the west coast. The mud sole (noncommercial varieties are known as "sand soles") probably provides the bulk of the catch; for in recent years the shallow-water grounds off Port Nolloth, where supersoles were formerly caught in large numbers, have unaccountably become depopulated. During the first two decades of this century the Agulhas sole was the mainstay of the trawling industry. Today it constitutes the *sine qua non* of the Agulhas Bank fisheries. Though rarely caught east of Cape Henderson, it occurs on muddy bottoms down to 60 fathoms from False Bay to Natal. It grows to a length of about 20 inches but does not reach sexual maturity until 12 inches long. Spawning takes place throughout the year, with a peak period during October and November.[11]

"Reds, pangas, and gurnards," third in the official statistics, provided 6.7 million pounds in 1948 but were valued at only £43,300. The most important

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[10] E. R. Roux and C. J. Molteno: Variations in the Oil and Vitamin A Contents of the Liver of the Cape Hake, *Journ. Soc. of Chemical Industry*, Vol. 65, London, 1946, pp. 281–284.

[11] J. M. Marchand: Report on Certain Investigations on the Agulhas Bank Sole-Grounds Lying between Cape Agulhas and Cape Infanta with Special Reference to the Question of Overfishing, *Union of South Africa Fisheries and Marine Biological Survey Rept. No. 10, for 1932*, Pretoria, 1933, pp. 110–143; reference on p. 131.

is the panga (*Pterogymnus laniarius*), which frequents moderately deep water between False Bay and Port St. Johns and is caught in quantity on the Agulhas Bank down to 60 fathoms. Next comes the red or Cape gurnard (*Chelidonichthys capensis*), taken in small quantities from the same grounds down to 50 fathoms. A few individuals of other species, notably the gray gurnard (*C. kumu*), but occasionally even red stumpnose (*Chrysoblephus gibbiceps*) and red steenbras (*Petrus rupestris*), complete the group.

Three other species each contributed a million pounds or more to the 1948 catch. Kingklip (*Genypterus capensis*), closely allied to the Australian rockling and found between 20 and 200 fathoms from St. Helena Bay to Algoa Bay,[12] yielded 2.2 million pounds, valued at £31,800. Kabeljou (*Sciaena hololepidota*), found throughout the year in all coastal waters down to 200 fathoms but concentrated in summer on the trawling grounds, added 1.8 million pounds, valued at £40,000. Maasbanker (*Trachurus trachurus*), related to the mossbunker, or menhaden, of the North Atlantic, occurs everywhere in South African waters; production amounted to one million pounds, valued at £5800.

The species mentioned furnished 97 per cent by weight and 98 per cent by value of the total catch. Other species in order of importance were jacopever (*Sebastichthys capensis*), silverfish (*Polysteganus argyrozona*), squids, white stumpnose (*Austrosparus globiceps*), red stumpnose, John Dory (*Zeus capensis*), red steenbras, skates, angelfish (*Holacanthus nicobariensis*), geelbek or Cape salmon (*Atractoscion aequidens*), and stone bass (*Polyprion americanus*).

The John Dory, a good table fish that occurs in abundance off the west coast, is seldom sold for food because the flesh rapidly becomes soft after capture. Together with such other common species as the banded or large-scaled rattail (*Coelorhynchus fasciatus*) and the smooth rattail (*Lionurus nigromaculatus*), it is used mainly in the manufacture of fish meal. In 1948 trawlers supplied 13.1 million pounds of material to the fish-meal industry.[13]

Trawling Grounds off the West Coast

Although the area of South African waters considered suitable for exploitation has been estimated to exceed 150,000 square miles,[14] the distribution of trawling grounds is limited by the nature of the sea bed. The presence

[12] K. H. Barnard: A Pictorial Guide to South African Fishes, Capetown, 1947, p. 193.

[13] This figure has not been included in the total of 83.5 million pounds which represents the landings of fish processed and marketed for human consumption.

[14] C. von Bonde: The South African Fishing Industries, *Ann. Proc. Associated Scientific and Technical Societies of South Africa, for 1941–1942*, Johannesburg, 1942, pp. 69–94; reference on p. 81.

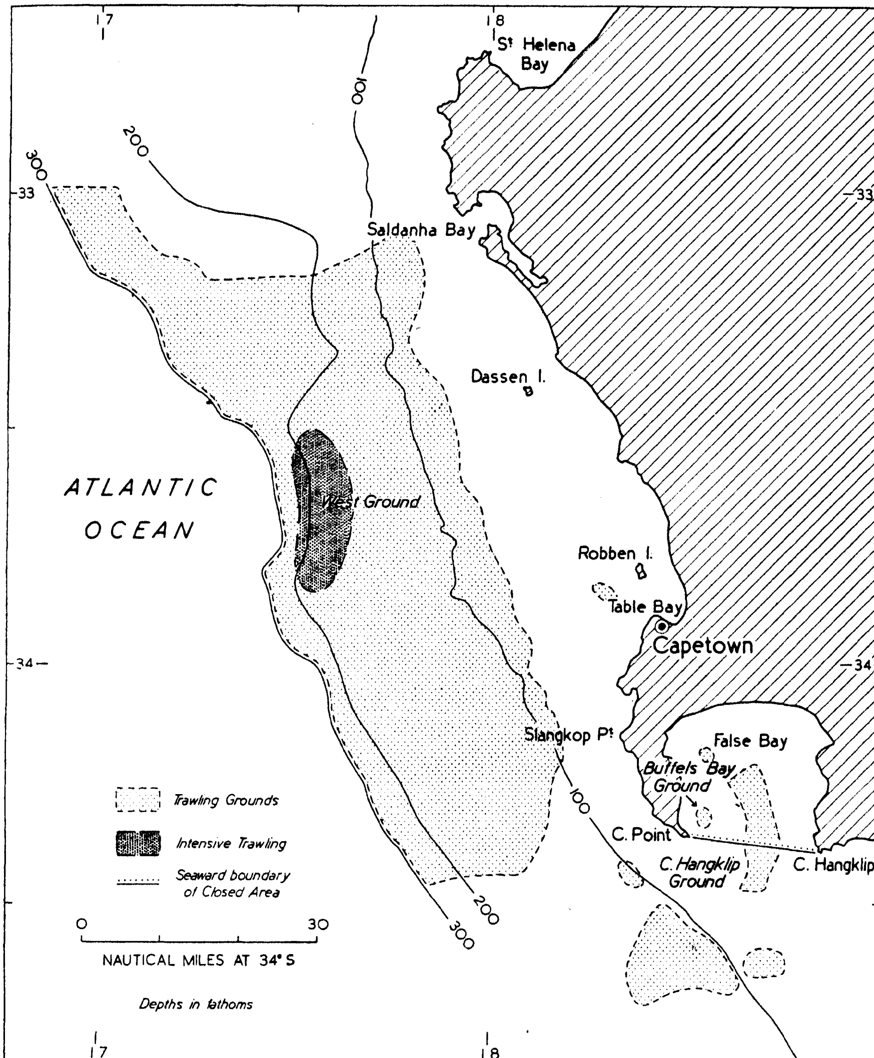


FIG. 2—Trawling grounds for stockfish between St. Helena Bay and Cape Hangklip. Bathymetric contours from analytical charts of the Division of Fisheries.

of rock and coral, which prohibits trawling over much of the continental shelf, especially on the Agulhas Bank, has necessitated the detailed survey and charting of commercial grounds by the Division of Fisheries.[15]

The most important producing area is the one known as the West

[15] Much of the material on the trawling grounds, including Figures 2–6, has been compiled from the reports of the Fisheries and Marine Biological Survey 1896–1946, from the analytical charts of the Division of Fisheries kindly placed at the writer's disposal by Dr. J. M. Marchand, and from information given by trawler skippers.

Ground, extending from Saldanha Bay to Cape Point (Fig. 2). Rocks close inshore limit the eastern boundary to the 77-fathom contour, and similar outcrops prohibit trawling immediately north and south of the ground. The West Ground was first discovered in 1920 and has been exploited with increasing intensity ever since. Trawlers operate exclusively between Dassen Island and Slangkop Point and mainly from 150 to 220 fathoms. The intensity of fishing is greatest in an area with an average depth of 185 fathoms located 45 nautical miles northwest of Capetown. This area provides about two-thirds of the Capetown landings. At present 12 trawlers operate daily throughout the year; the annual average catch per trawler-day ranges from 15,000 to 20,000 pounds.[16] The trawl is usually towed in a southerly direction along the isobath and yields 1000 to 5000 pounds of fish in a 2-hour drag. Catches of stockfish and kingklip, the principal food species caught, are normally good. Shallower waters contain fewer kingklip and a higher proportion of small stockfish. Deeper waters are characterized by a gradual falling off in catches as far as 300 fathoms and by a strong southwesterly current that hinders operations, particularly in the north. Consequently the only area where trawling normally takes place to a depth of 300 fathoms lies in the extreme south, due west of Slangkop Point.

Potential trawling grounds also occur farther north. The eastern limit to these grounds ranges from 13 fathoms off the Orange River mouth to 60 fathoms off St. Helena Bay. The western limit is the 300-fathom contour. These grounds are only irregularly fished at present, being exploited occasionally for stockfish and kingklip during the winter when there is a marked seasonal decline in yields from the West Ground. Formerly supersoles were sought, mainly on the so-called North Ground off Port Nolloth, by small trawlers operating from Capetown.

Several grounds of minor importance occur around the Cape Peninsula. One of the earliest to be exploited is in Table Bay, where tugs from Capetown regularly conducted trawling operations during the nineties.[17] The ground is too small and too sparsely populated for modern trawling. Another ground that is seldom exploited today lies eight miles northwest of Table Bay in 40 fathoms. False Bay, the scene of early trawling activities extending over 30 years, has been closed to trawling since 1928 in order to protect the inshore fisheries. A line joining Cape Point and Cape Hangklip forms the southern

[16] E. R. Roux: Hake Catch Data from the West Ground, *South African Science*, Vol. 2, Johannesburg, 1948–1949, pp. 144–147; reference on p. 145.

[17] For the early history of trawling in South African waters see W. W. Thompson: The Sea Fisheries of the Cape Colony, Capetown, 1913, pp. 64–79.

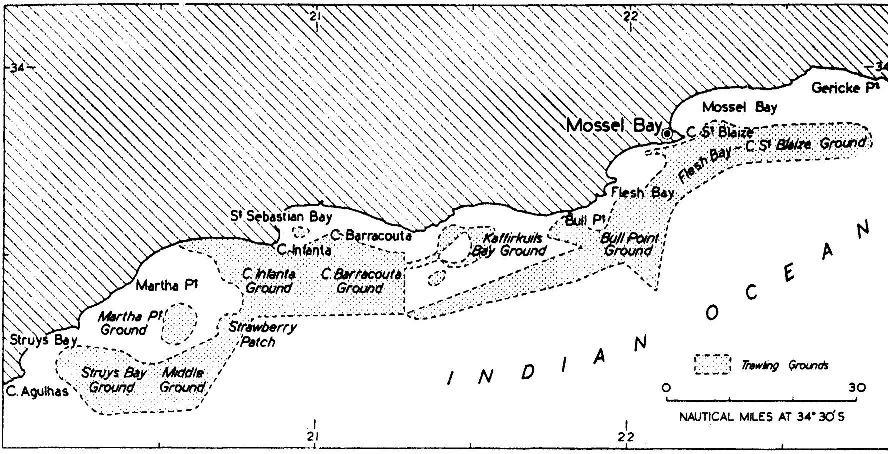


FIG. 3—Trawling grounds from Cape Agulhas to Mossel Bay. The sole fishery of the Agulhas Bank is centered between Cape Agulhas and Cape Infanta.

boundary to the prohibited area and the northern boundary to the Cape Hangklip Ground. This ground extends southward from 40 fathoms to a low submarine ridge, a continuation of the Cape Peninsula, in 70 fathoms. It is frequently fished by trawlers returning to Capetown from the Agulhas Bank. Prolific yields of pangas and small yields of stockfish, silverfish, and gurnards are normal.

Farther south, and due west of Danger Point, is a small stockfish area just inshore from the 100-fathom contour, separated by rocky outcrops from the larger trawling area between 100 and almost 200 fathoms. The muddy bottom of these areas, in contrast with the unobstructed mud bottom of the West Ground, is at present covered with sponges and other sessile marine growths, which tend to block the meshes of the otter trawl, especially of the cod end. Whether this is due to the fact that these are virgin grounds which have yet to be swept clean or to the mixing of the cold and warm currents that produces sea temperatures favorable to the development of both warm- and cold-water growths has still to be established. The trawling industry regards these grounds merely as reserves, even though they appear to be well populated with stockfish during the months of seasonal scarcity on the West Ground. Another potential ground lies between Cape Hangklip and Danger Point from 100 to 300 fathoms.

Trawling Grounds off the South Coast

On the Agulhas Bank the trawling grounds are by no means so extensive as may be popularly supposed. Areas of clear mud bottom are interspersed with outcrops of rock and coral and are usually too small and too widely

scattered to be trawled economically. All the grounds visited by Capetown trawlers, which may operate as far east as Mossel Bay, are within 25 nautical miles of the coast (Fig. 3). Here between Cape Agulhas and Cape Infanta lies the valuable sole fishery. On the Struys Bay Ground, which slopes gradually from 25 to 50 fathoms and merges eastward into the so-called Middle Ground, trawling is confined to the northern and shallower waters, where, in contrast with the waters farther south, the greenish mud bottom is free from rocks, contains a lower proportion of sand, and appears to be more heavily populated with soles. The occurrence of soles in payable quantities on the small Martha Point Ground, located between 36 and 50 fathoms, fluctuates considerably with local migrations to and from the area. Due east of the Martha Point Ground the predominance of sedentary invertebrates, mainly red bait or sea squirts, has caused the trawlable area to be known to trawler skippers as the "Strawberry Patch." South of latitude 34° 36′ S. on the important Cape Infanta and Cape Barracouta Grounds, where depth ranges only from 30 to 40 fathoms, the presence of sand, which predominates over mud in the sea-floor deposits, means the absence of soles. Within the rest of these grounds local migrations, mostly either from north to south or vice versa, often necessitate exploratory steaming and trial hauls before fishing can begin. The Agulhas Bank sole grounds, in common with the shallow-water grounds off the southeast coast, abound in a great variety of fish. Species such as panga, white stumpnose, and gurnard, which fetch low market prices, are obtainable in large quantities, whereas stockfish and kabeljou, far more valuable fish, seldom supply good catches.

The Cape Barracouta Ground is connected by the "Channel" with the Kaffirkuils Bay Ground. On the northern and central parts of this ground and over most of the Channel lies a thick layer of mud comparable to the bottom deposits of the northern Cape Infanta Ground. On the southern parts, however, and on the small unfrequented ground south of the Channel, the deposits consist of almost horizontal sandstone beds overlain by a thin layer of mud through which the sandstone occasionally outcrops on the surface. The difference in bottom deposits is reflected in the different methods of trawling employed. To prevent damage to gear on sandstone outcrops, the length of trawl-warp shot never exceeds three times the depth of water fished, but on muddy bottoms long trawl warps are used in order to dig out the soles from the mud in which they lie. The depth of water on these grounds ranges from 30 to 37 fathoms.

An elongated trawling area, known as the Bull Point and Flesh Bay–Cape St. Blaize Grounds, stretches from Cape Barracouta eastward to Gericke

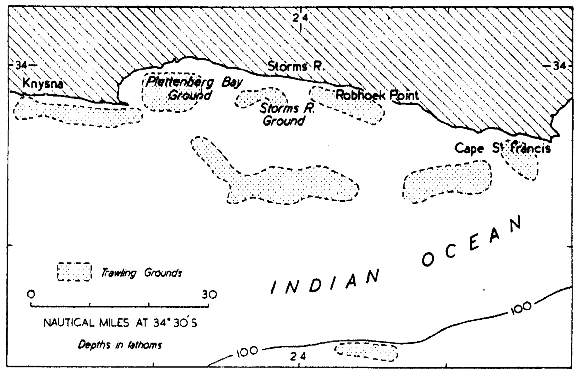


FIG. 4—Trawling grounds between Knysna and Cape St. Francis. One-hundred-fathom contour from British Admiralty Chart No. 2084.

Point. Although the shallower parts close inshore have been accurately demarcated, the seaward limits remain somewhat conjectural. As far as the sole fishery is concerned, the 45-fathom line represents the seaward limit of profitable fishing. The area is regularly fished by small trawlers and line-fishing boats based on Mossel Bay but is seldom visited by Capetown vessels.

Trawlers operating from Mossel Bay confine their activities to local grounds. Those based on East London, and most of those from Port Elizabeth, may be seen occasionally as far west as Plettenberg Bay (Fig. 4). The grounds lying between Knysna and Cape St. Francis[18] have not been consistently exploited, largely because they cover relatively small areas isolated among outcrops of rock.

Trawling Grounds off the Southeast Coast

The otter-trawl fisheries of the southeast coast are concentrated between Cape St. Francis and Port Alfred (Fig. 5). Trawlers conduct regular operations on the Jeffreys Bay Ground, and within Algoa Bay the Roman Rock Ground, sheltered from westerly and northerly winds and near the safe harborage and large urban market of Port Elizabeth, has long been intensively exploited. Prolific breeding grounds for soles, kabeljou, and geelbek lying within three nautical miles of the west shore of Algoa Bay have been closed to trawling since September, 1935. From this sanctuary immature fish often invade the St. Croix Island Ground, normally trawled only when weather prevents operations on the more exposed grounds farther south and the larger, frequently exploited Devlins Farm Ground. Of the Cape Padrone Ground the northern and shallower areas are, in general, the most productive. Numerous small grounds also occur; but even if trawler skippers were

[18] In the absence of an official survey, the boundaries of the small deep-water ground south of Robhoek Point and beyond the 100-fathom contour have been drawn from somewhat unreliable evidence submitted by trawler skippers.

sufficiently good navigators to establish dan buoys in the center of such grounds, the risk of losing gear and the relatively low catch per unit of effort would prohibit commercial fishing. Trawling grounds along the southeast coast, though densely populated with fish when the prevailing winds are easterly or southeasterly, become depopulated, especially of kabeljou and pangas, during the heavy swells caused by westerly and southwesterly winds.

The Cape Padrone Ground is the nearest commercially significant ground to East London, 80 nautical miles away. Of the seven smaller grounds close inshore between Port Alfred and Stony Point, the Chalumna River Ground, 15 miles southwest of East London in less than 50 fathoms, is regularly fished by trawlers homeward bound from the grounds farther west (Fig. 6). Isolated rough patches along the boundary confine trawling to the central part. Off East London two small grounds occur but are never exploited. Grounds northeast of the port are too remote for regular trawling. Twenty miles away lies the Cape Henderson Ground, where depth ranges from 20 to almost 50 fathoms. The Bowkers Bay Ground, 35 miles from port, has the added disadvantage of being so small that trawlers and their gear can maneuver only with difficulty. Consequently, this ground lying between 23 and 37 fathoms is rarely if ever visited by commercial trawlers.

A winter scarcity of stockfish, probably due to migration to deeper waters, has handicapped the development of the trawling industry at Port Elizabeth and East London. Before 1935 the only grounds known and regularly exploited were those lying close inshore, but in an attempt to find alternative winter resources, deep-water areas were surveyed during the years 1935–1937. A suitable sea floor was discovered beyond the 100-fathom contour off East London, but the data obtained were insufficient to enable trawlable areas to be demarcated. Two grounds, however, were discovered off Port Elizabeth, both lying on the upper part of the relatively steep continental slope between the 100 and 300-fathom contours. The first area, which ranges in width from 9 nautical miles in the extreme west to just over a mile in the east, extends 80 miles from south of Cape St. Francis, the western limit of survey, to the longitude of Bird Island. Farther east lies a 20-mile section of untrawlable bottom, followed by a second ground only 15 miles in length, beyond which the bottom again becomes untrawlable. The sea-floor deposits over these grounds are composed of rather coarse sand and broken shell, together with varying amounts of finely broken coral. Distributed over the untrawlable sections, in addition to these deposits, are numerous hillocks of clayey sandstone, partly or wholly covered with coral. East of Cape Receife the submarine escarpment becomes more and more dissected by canyons.

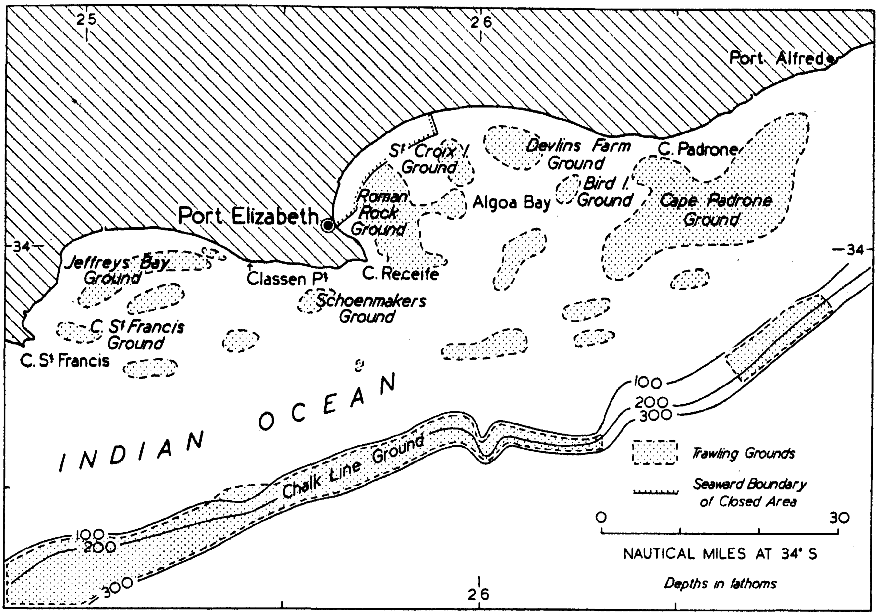


FIG. 5—Trawling grounds from Cape St. Francis to Port Alfred. Bathymetric contours from analytical charts of the Division of Fisheries.

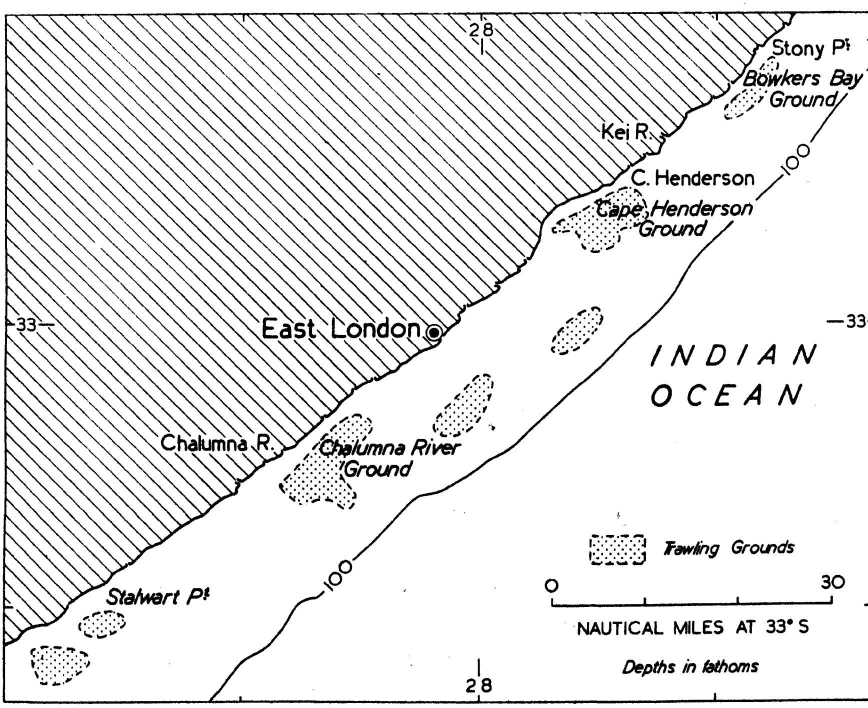


FIG. 6—Trawling grounds between Port Alfred and Stony Point. One-hundred-fathom contour from British Admiralty Chart No. 2086.

Together these deep-water grounds are known to trawler skippers as the Chalk Line Ground. Commercial trawling began in 1935 and has been confined almost entirely to the central and western parts of the main ground. The strong Agulhas Current, occasionally reaching five knots, necessitates towing the trawl westward with the current. The only fish caught in commercial quantity are kingklip, a species rarely caught on the shallow-water grounds, and stockfish, which migrates even from these deep-water grounds during the winter. Winter trawling is further handicapped by the prevailing westerly winds, which often blow at gale force for several days without slackening. Being in opposition to a strong current, they produce heavy seas that make trawling hazardous if not impossible. The importance of these grounds, however, is shown by the great increase in the annual landings at Port Elizabeth and East London immediately after their discovery.

Along the Natal coast no trawling ground of commercial importance has yet been found. Although the Natal or Gilchrist's crawfish (*Palinurus gilchristi*) is widely distributed in varying density over 100 square miles from 130 to 230 fathoms within 15 miles of Durban, exploitation in the near future seems unlikely. The scattered and changing nature of its distribution, the strong current, and the irregular occurrence of rock and coral over the sea floor would make trawling too expensive to compete with the flourishing west-coast fishery, based on a larger, more abundant, and far more cheaply obtainable species of crawfish (*Jasus lalandii*).[19]

Trawlers and Ports

Tugs and launches were already engaged in experimental trawling when the first steam trawler, the *Pieter Faure,* arrived in Table Bay in 1897. This vessel, built at Glasgow for the Cape government, had been specially designed for fishery survey. In the search for fishing grounds the *Pieter Faure* proved to be so successful that by the turn of the century commercial trawlers had begun operations on the Agulhas Bank. By 1913, when the trawl catch had increased to 14 million pounds annually, eight trawlers were operating. In 1938 landings had reached 40 million pounds and trawlers numbered 25.

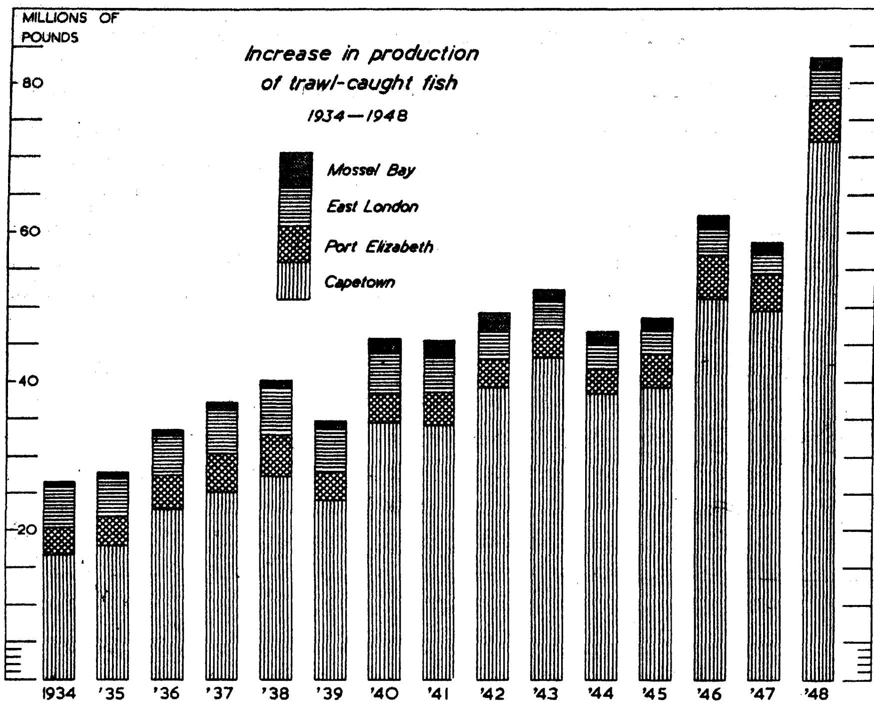
[19] The Cape crawfish, which occurs in large quantities between low-water mark and the 25-fathom line off the west coast, is caught by the use of simple hoop nets let down from dinghies. A motorboat 25 to 65 feet long tows the dinghies and transports the catch to harbor. The industry is concerned primarily with the export market: canned crawfish are sent mainly to the United Kingdom, and frozen crawfish tails to the United States. Domestic demand is small. Although statistics of annual landings are not available, an estimate of 20 million pounds (of which two-thirds is discarded during processing or utilized as offal) has been made by S. H. Skaife in his "The Fishing Industry of South Africa," *South African Science,* Vol. 1, 1947–1948, pp. 197–199; reference on p. 198.

With the outbreak of war many trawlers were requisitioned for national service. Those that remained of the Capetown fleet were mainly concentrated on the West Ground in an effort to increase production at the expense of variety. Thus annual landings continued to rise despite a depleted trawling fleet. Since the war the fleet has rapidly expanded. The 1948 catch was landed from 40 trawlers, manned by fewer than 800 men and owned by five companies. Thirty trawlers were based on Capetown, four on Port Elizabeth, three on East London, and three on Mossel Bay.

The size and design of South African otter-trawl vessels and their distribution among the four trawling ports reflect the distribution and productivity of the principal fishing grounds. Most of the trawlers were built at Aberdeen, Scotland, but others were built at Capetown, in Sweden, and at Newcastle-upon-Tyne and Selby in England. Those built at Capetown are 75-foot wooden motor trawlers designed for fishing on the Agulhas Bank. Those built in Britain are larger vessels designed for deeper waters. At Capetown most vessels are steam trawlers of 250 to 515 tons gross, fitted with triple-expansion engines. They range from 120 to 165 feet in length, have a bunker capacity of about 180 tons, and a fish capacity of 160 tons. The warm climate necessitates heavy insulation of the fishroom, which normally includes storage for offal and livers. Before the war, trawlers were manned almost entirely by Europeans, but manpower shortage has led to the employment of numerous Cape colored fishermen as deck hands. A crew consists of 15 to 30 men. Trawlers operate mainly on the West Ground. They remain at sea for 7 or 10 days, even though the ground may be reached within four hours of leaving port. In 1948, Capetown trawlers landed 72.2 million pounds, or 86 per cent of the total catch (Fig. 7).

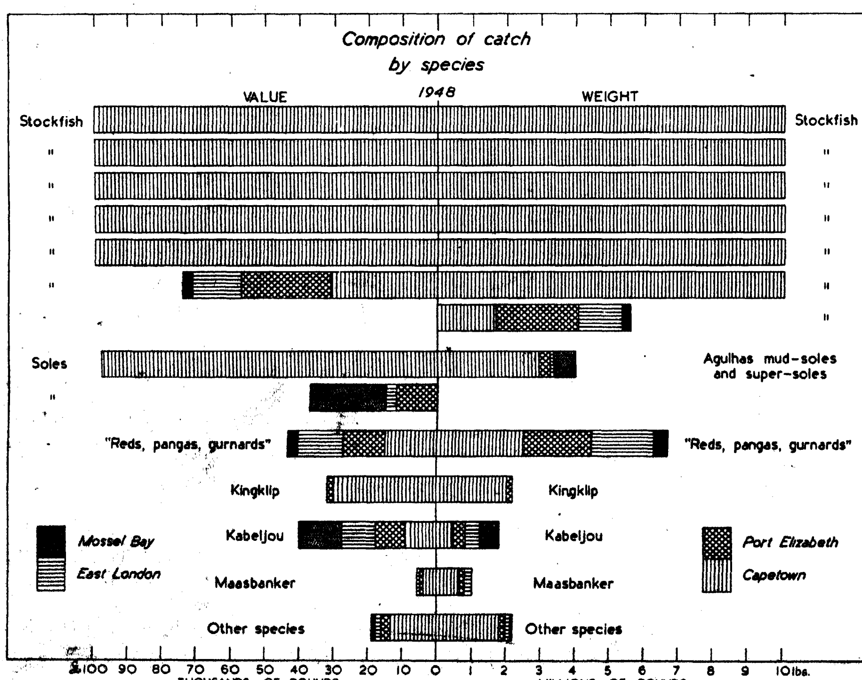
Before 1942, the year in which Port Elizabeth assumed second place among the Union's trawling ports, East London had always landed a larger catch. The increasing importance of Port Elizabeth and the relative decline of East London arose directly from the development of the Chalk Line Ground. Deep-water trawling in strong currents demands moderately large steel vessels. Consequently, most vessels at Port Elizabeth are 130-foot steam trawlers carrying a crew of 20 men and having capacity for 40 to 60 tons of fish. A 90-foot wooden motor trawler with a fish capacity of 20 tons, built in Sweden as a line-fishing vessel in 1938, is used for inshore fishing. The Port Elizabeth catch in 1948 was 5.5 million pounds, or 6.5 per cent of the total landings.

The same number of trawlers operate from East London and Mossel Bay. East London trawlers conduct large-scale operations either on the Chalk



MILLIONS OF POUNDS
Increase in production of trawl-caught fish
1934—1948
Mossel Bay
East London
Port Elizabeth
Capetown
80
60
40
20
1934
'35
'36
'37
'38
'39
'40
'41
'42
'43
'44
'45
'46
'47
'48

FIG. 7



Composition of catch by species
VALUE
1948
WEIGHT
Stockfish
Soles
Agulhas mud-soles and super-soles
"Reds, pangas, gurnards"
Kingklip
Kabeljou
Maasbanker
Other species
Mossel Bay
East London
Port Elizabeth
Capetown
100 90 80 70 60 50 40 30 20 10 0 1 2 3 4 5 6 7 8 9 10lbs.
THOUSANDS OF POUNDS
MILLIONS OF POUNDS

FIG. 8

Line Ground or on inshore grounds as much as 250 nautical miles from port. They range from 190 to 270 tons gross, from 115 to 125 feet in length, and from 50 to 75 tons in fish capacity. Crews consist of 18 to 22 men. Mossel Bay trawlers are designed for local fishing. All of them are 96 tons gross, 86 feet long, and have a fish capacity of only 10 tons. Their crews number 12. In 1948, East London trawlers landed 3.9 million pounds, or 5 per cent of the catch; Mossel Bay trawlers caught 1.9 million pounds, or about 2.5 per cent.

Otter-trawl nets in current use range from 90 to 120 feet in length and from 120 to 160 feet across the mouth. During trawling the mouth is kept open by the pressure of water against the otter boards attached to the cables some distance in front of the net. The larger trawl nets are used on the West Ground during drags lasting from 1½ to 2 hours. Trawl nets employed during 3 or 4-hour drags on shallow-water grounds do not exceed 110 feet in length and 145 feet across the mouth.

Regulation of the Otter-Trawl Fisheries

The aim of fishery conservation should be so to adjust the size composition of the stock to the available food supply that a maximum annual increase in weight, and therefore a maximum annual return to the fishing industry, would result. South African fishery statistics, which record only the weight of fish landed, provide a wholly inadequate basis for assessing the stocks of commercial species.[20] From the scanty evidence available, the increasing intensity of fishing does not yet seem to have depleted the stocks. Nevertheless, the regulation of South African fisheries, which came under Union control in 1940[21] after having been the responsibility of individual provinces since 1909, imposes limitations on the size of the cod end that may be used, on the length of fish that may be caught, and on the areas of trawling.

Mesh regulations arose from the necessity of preventing the mass destruction of immature stockfish and Agulhas soles. During surveys of the West Ground undertaken in 1932, it was established that great quantities of stockfish too small to be of marketable value were being caught by commercial trawlers and subsequently dumped overboard. This useless destruction, often amounting to 50 per cent of a catch, was investigated in 1935 by the Division of Fisheries. At that time the trawl net in commercial use had a cod-end mesh of 2½ inches, which retained the majority of stockfish more than 10 inches

[20] For many years the Division of Fisheries has urged the adoption of a comprehensive statistical system. See, for example, C. von Bonde: Can Scientific Research Assist the Fishing Industry? *Official Journ. Dept. of Commerce and Industries*, Vol. 1, No. 9, Pretoria, 1939, pp. 13–20; reference on pp. 19–20.

[21] Sea Fisheries Act, October 25, 1940 (Act No 10 of 1940).

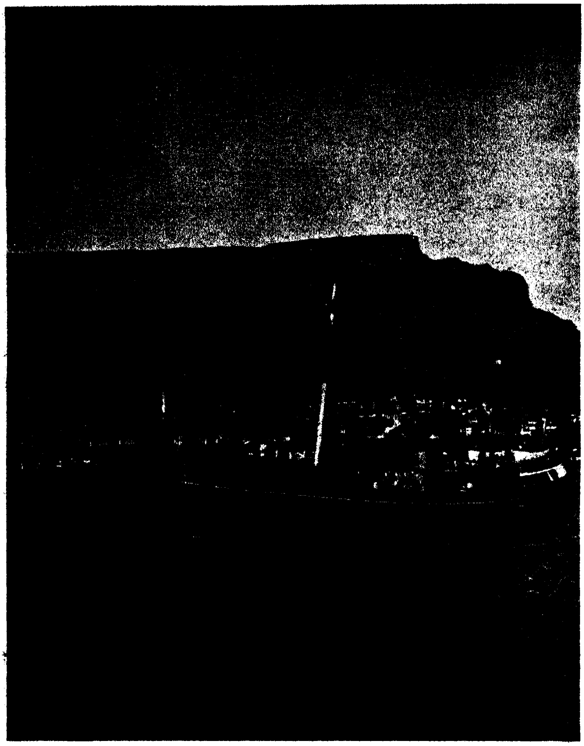


FIG. 9—Steam trawler leaving Table Bay harbor for the West Ground. (Photograph by Press Photo Service, Capetown.)

long. The investigations revealed that a cod-end mesh of 4 inches permitted the escape of "a considerable percentage of the unmarketable and immature stockfish up to 23 inches in length captured,"[22] and that the catch of commercially valuable fish was only 4 per cent less than that obtained with the gear normally used. Regulations prescribing a minimum cod-end mesh of 4 inches (2-inch bar) were accordingly promulgated and have been in force since January, 1938. They apply to all trawl nets used in coastal waters between the Orange River mouth and the longitude of Cape Point.

Recent investigations have shown that a mesh of 2-inch bar prevents the escape of all fish 19 inches or more in length, and that owing to the capture of even smaller fish, 19 inches may now be regarded as the average length of the catch.[23] Since female stockfish are immature at this length, their capture in large quantities, combined with the growing intensity of fishing, might eventually deplete the stock. At present, however, there appears to be little danger of overfishing.[24]

On the other hand, the declining productivity of the Agulhas Bank sole grounds had become evident by 1932. Savings-trawl investigations carried out during 1933 and 1935 revealed that a cod-end mesh of three inches permitted the escape of large numbers of soles less than 12 inches long which the

[22] J. M. Marchand and W. Taylor: Savings-Trawl Investigations in South African Waters during 1935, *Union of South Africa Fisheries and Marine Biological Survey Investigational Rept. No. 8,* Pretoria, 1936, p. 18.

[23] E. R. Roux: The Growth Rate of the Cape Hake or Stockfish, *South African Science,* Vol. 1, 1947–1948, pp. 46–48.

[24] *Idem,* Hake Catch Data from the West Ground (*op. cit.*).

smaller mesh of the standard commercial gear would have retained.[25] Since the sole is the mainstay of the Agulhas Bank fisheries, the adoption of a cod-end mesh larger than three inches, which would have prevented the capture of undersized stockfish but enabled marketable soles to escape, was obviously uneconomic. Regulations enforcing the introduction of the three-inch mesh were accordingly promulgated and have been in force since September, 1935. They apply to all trawl nets used in coastal waters from Cape Point to the Natal-Mozambique frontier. Nevertheless, many immature soles, known commercially as "slips," appear to find their way onto the market.

FIG. 10—The otter-trawl net on a steam trawler. Note the method of rebunkering—natives carrying baskets of coal.

Despite mesh regulations, the otter trawl can never become a highly selective gear. Consequently, regulations forbidding the capture or marketing of fish below minimum size limits are designed primarily to restrict the activities of deep-sea line fishermen. But the size limits apply not only to species, such as stockfish, kabeljou, stumpnose, steenbras, and geelbek, caught both by trawl and by line but also to species landed almost exclusively by trawlers. The otter-trawl fisheries are, in fact, subject to the following minimum size limits: kingklip, 24 inches; stockfish, 20 inches; kabeljou and geelbek, 16 inches; Agulhas sole and steenbras, 12 inches; silverfish, 9 inches; and stumpnose, 8 inches. For the remaining trawl-caught species no legal size limits have yet been prescribed.

[25] J. M. Marchand: Savings-Trawl Investigations in Relation to the Conservation and Regulation of the Agulhas Bank Sole-Fishery, *Union of South Africa Fisheries and Marine Biological Survey Investigational Rept. No. 1*, Pretoria, 1934; Marchand and Taylor, *op. cit.*, pp. 6–12.

Because of the difficulty of enforcing closed fishing areas, particularly without adequate fishery patrols, only two sanctuaries, False Bay and a western part of Algoa Bay, have been proclaimed. The relatively low productivity of the False Bay grounds, together with the presence of ammunition in large quantities dumped on these grounds by the naval authorities, suffices to ensure immunity from trawling. The extent and importance of the Algoa Bay sanctuary have already been indicated. A further area has been closed to trawling since 1946, owing to canisters of mustard gas dumped off

FIG. 11—The harbor at Capetown. (Photograph by Press Photo Service, Capetown.)

Port Elizabeth having drifted onto the valuable Chalk Line Ground. Nearly 10,000 tons of mustard gas, high explosive, and ammunition were dumped. The prohibited area extends 40 miles seaward between the bearings 120° from Cape Receife and 180° from Classen Point.

HANDLING AND MARKETING THE CATCH

Nearly 80 per cent of the total otter-trawl catch is sold as fresh or frozen fish. Of the Capetown landings about 30 per cent is sold in the local market. Johannesburg, the most important inland distributing center, receives 25 per cent for distribution throughout the Transvaal, Northern and Southern Rhodesia, and Portuguese East Africa. The western Cape Province, High Commission Territories, and Durban normally take 20 per cent.

A further 20 per cent is supplied to the Capetown smokeries. Within the last 10 years smoked fillets, mostly stockfish but including soles, have largely ousted imported smoked haddock from the home market and have provided a surplus for export to Australia, Singapore, and Hong Kong. Small quantities of smoked maasbankers compete with imported kippers in the local market. Smokeries engaged in processing trawl-caught fish employ about 250 persons.

Stockfish livers, representing almost 3.5 per cent of the Capetown catch,

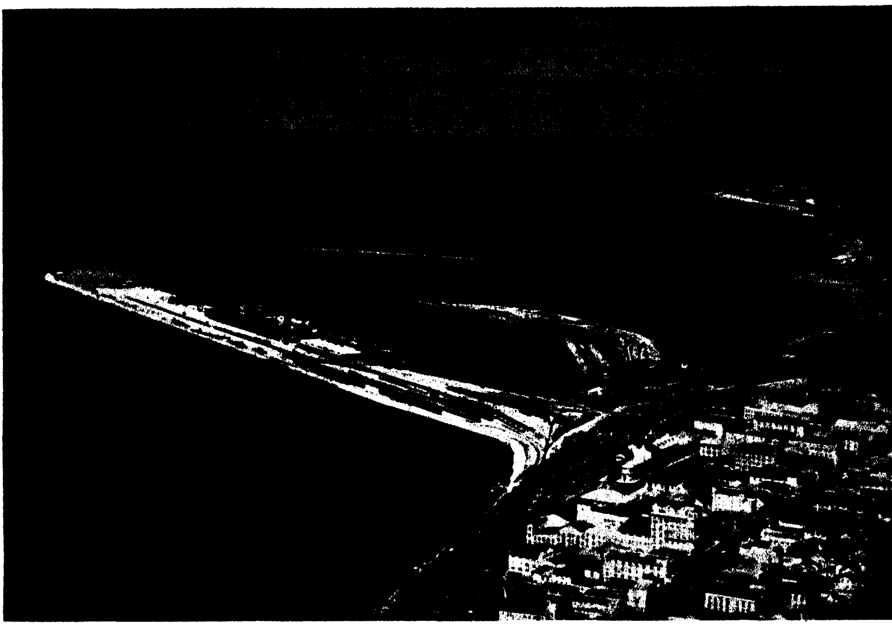


FIG. 12—The harbor at Port Elizabeth. (Photograph by South African Railways.)

are used in the manufacture of vitamin-bearing oil. Factories are located both at Capetown and at Port Elizabeth, the latter a branch that takes 3 per cent of the local catch. In 1948 the combined output was probably about 88,000 gallons, most of which was exported to the United States and Great Britain.

A canning factory at Maitland took the remaining 1.5 per cent of the Capetown landings. Approximately one million pounds of stockfish and small quantities of maasbanker and other trawled fish were canned. Unfortunately, stockfish is rather tasteless when packed by itself and is therefore usually canned in mustard sauce or in the form of fish cakes and fish balls. In the near future no great expansion in the canning of trawl-caught fish seems to be likely. The home market, which absorbs the bulk of the output, appears to be saturated already.

In the past the other three centers of the otter-trawl fisheries have been limited in their development both by the relatively small supply of fish obtainable from the waters of the Agulhas Current and by the absence of large urban markets in their immediate hinterlands. Port Elizabeth and neighboring towns, such as Uitenhage, Graaff Reinet, Grahamstown, and Port Alfred, normally consume more than 70 per cent of the Port Elizabeth catch; the remainder is distributed through the Orange Free State and the Transvaal. Similarly, three-quarters of the East London catch is usually sold in the local market, chiefly to the hotel industry, and in such towns as Aliwal North, Kingwilliamstown, Queenstown, and Umtata, all of which have rail connections with the port. Occasionally, when continuous easterly winds, bad weather, or other factors have resulted in small landings at East London, the immediate hinterland has been supplied from one of the other ports. Normally, however, East London dispatches a surplus to Bloemfontein and Johannesburg and, when catches are abnormally large, to Durban also. In contrast, Mossel Bay is concerned almost entirely with local distribution and the preparation of smoked fillets for export.

The Future

That the otter-trawl fisheries are capable of considerable further expansion is certain. Unlike other areas of the world's fisheries, South African coastal waters could be far more intensively fished than at present without depleting the resources. Of the prolific west-coast waters only 300 square miles have been consistently exploited. On the Agulhas Bank, in spite of the fact that large tracts remain to be surveyed in detail, unsuitable bottom and small fish stocks will undoubtedly restrict development. But even here, the charting and development of deep-water grounds comparable to the Chalk Line Ground do not appear to be unlikely. Long-term programs of survey and research are being pursued both by the Division of Fisheries, whose staff and equipment have been greatly expanded since the war, and by the Fisheries Research Institute, established in 1946 by the fishing industry in collaboration with the Council for Scientific and Industrial Research.

Home consumption, as well as production, could be substantially increased. The annual per capita consumption of fish in South Africa is only 7 pounds. The European community, relatively a small section of the population, are as yet the only consumers. Despite taboos against the eating of fish held by many Bantu tribes, an effective contribution can be made toward improving the health of African peoples. The present Bantu diet, consisting chiefly of maize and sour milk, has caused malnutrition and deficiency

diseases to become chronic among the native population. The Basutos, for example, who have no taboo against eating fish, suffer from serious protein deficiency and a high incidence of liver disease. Yet Maseru, the capital of Basutoland, is only 86 miles by rail from Bloemfontein, an important wholesale distributing center. Of vital importance are the Transkeian Territories, which have suffered acutely, and continue to suffer, from excessive overgrazing, accelerated erosion, a decreasing milk and meat supply, widespread protein and vitamin deficiencies, disease, and heavy infant mortality. Proximity to East London should facilitate the provision of a cheap supply of fish protein, but the small native purchasing power and the Bantu prejudice against eating fish have so far militated against this development. However, the native demand will almost certainly increase with changes in the traditional diet already apparent in the Ciskei and with the establishment of industrial settlements. Native communities attached to the gold mines that are being developed in the Orange Free State will require an abundance of cheap food. Zwelitsha, a native township in course of construction within 20 miles of East London, will eventually contain 10,000 inhabitants, with a purchasing power higher than that of natives in the reserves. The development of such potential markets will not only contribute to the expansion of the otter-trawl fisheries but promote the welfare of native peoples throughout South Africa.

ZAMBEZI-OKOVANGO DEVELOPMENT PROJECTS

JOHN H. WELLINGTON

DURING the next decade it is probable that the basin of the Zambezi will undergo great changes, resulting not only from spectacular constructions along its course but also from associated Rhodesian industrial developments. The key to these changes is the Kariba gorge, where the Zambezi narrows to less than a hundred yards as it cuts through a barrier in the Middle Zambezi Trough (Figs. 1 and 3).

The Zambezi Drainage Basin

For a proper understanding of the significance of the Kariba gorge and its relation to possible developments in the northern Kalahari, it is necessary to have in mind the Zambezi drainage basin as a whole. From its source on the great Benguela-Katanga continental divide, the Zambezi, in the 1700 miles of its course, flows through three distinct morphological regions: the Angola Plateau, the Middle Zambezi or Rhodesian Trough, and the Mozambique Plain.

The plateau section of the river extends from the watershed to a point 60 miles below Victoria Falls, where it passes from the Batoka gorge into the trough tract. In this upper basin the river's course has undoubtedly been determined by the surface of the Kalahari formation, which extends northward from near the Orange River more than 1600 miles, unbrokenly to about 13° S. in Angola and Northern Rhodesia, and fragmentarily to 5° S. in the southern Congo basin. Its greatest width is about 1100 miles, from outliers as far east as 31° E. in Southern Rhodesia westward to about 15° E. in South West Africa. The Kalahari sand, the most extensive unbroken surface of sand in the world, overlies a Miocene(?) peneplain and itself forms a "peneplain of accumulation," the sand apparently conforming to slight rises and depressions in the pre-Kalahari surface.[1]

It is generally presumed that the Congo and Zambezi basins were formed by warping of the Kalahari-covered Miocene surface. However that may be,

[1] For a discussion of the relationship between the Kalahari and the Miocene peneplain see A. C. Veatch: Evolution of the Congo Basin, *Geol. Soc. of America Memoir 3*, 1935; and, more recently, E. Polinard: Considérations sur le système du Kalahari et ses dérivés au sud du Congo belge, entre le Kwango et le Katanga, *Mémoires Inst. Royal Colonial Belge, Section des Sciences Naturelles et Médicales*, Vol. 17, No. 2, 1948.

➤ Dr. Wellington is professor of geography at the University of the Witwatersrand, Johannesburg, and the author of numerous articles on the physical and human geography of South Africa.

the present drainage of the Zambezi basin has undoubtedly originated on the surface of the Kalahari formation, from which it has been, and still is being, superimposed on the underlying rocks. These include formations of the Karroo system (Upper Carboniferous–Triassic)—of which the uppermost and most resistant is the Batoka (Stormberg) basalt—and of the Waterberg (Cambrian) and Ventersdorp (Proterozoic) systems, whose quartzites and lavas project here and there through the sand mantle. Except near the sand margin, however, the nature of the sub-Kalahari surface is little known.

Where the Zambezi is superimposed on resistant rocks, rapids or gorges result. The first of these begins at the southern end of the sandy Barotse plain, which the river floods in summer. From here southeastward to Katima Molilo, a distance of about 60 miles, the river has exposed the Batoka basalt and has begun to cut through it in a series of rapids. It then enters another sand basin, the Shesheke plain, about 80 miles long, through which it meanders with a gradient between three and four inches to the mile. Here, again, the river in time of flood overflows its banks, streaming mainly southward to join the swamp waters of the Linyanti. This Shesheke plain ends at the next exposure of the Batoka basalt, at the rapids of Mambova. Fifteen miles downstream the river crosses another and greater exposure of the basalt at Katombora, falling 30 feet in two miles. In the next 35 miles the river has completely denuded the basalt of its Kalahari covering, and at Victoria Falls (Fig. 5) it plunges 358 feet into the Batoka gorge, which deepens to more than 800 feet at its mouth, some 60 miles to the east.[2]

About 40 miles beyond the end of the gorge the river swings northeastward into the Middle Zambezi Trough, formed by the downfaulting of pre-Karroo and Karroo beds. The faults are staggered on the southern side[3] but form a reasonably continuous double scarp on the northern side. For about 200 miles this post-Karroo (early Cretaceous?)[4] rift valley is followed by the Zambezi; beyond the Kafue confluence, however, the continuation of the northeastward-trending rift valley is occupied by the Luangwa River, while the Zambezi turns into the eastward-trending trough whose southern margin is formed by the impressive Mavuradona scarp.[5] From the eastern

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[2] G. W. Lamplugh: The Gorge and Basin of the Zambezi below the Victoria Falls, Rhodesia, *Geogr. Journ.*, Vol. 31, 1908, pp. 133–152 and 287–303.

[3] A. M. Macgregor: An Outline of the Geological History of Southern Rhodesia, *Southern Rhodesia Geol. Survey Bull. No. 38*, 1947.

[4] For a discussion on the age of this valley see Frank Dixey: The Early Cretaceous Valley-Floor Peneplain of the Lake Nyasa Region and Its Relation to Tertiary Rift Structures, *Quart. Journ. Geol. Soc.*, Vol. 95, for 1939, London, 1940, pp. 75–108.

[5] The scarp is beautifully shown in Richard U. Light: Focus on Africa, *Amer. Geogr. Soc. Special Publ. No. 25*, 1941, Fig. 86.

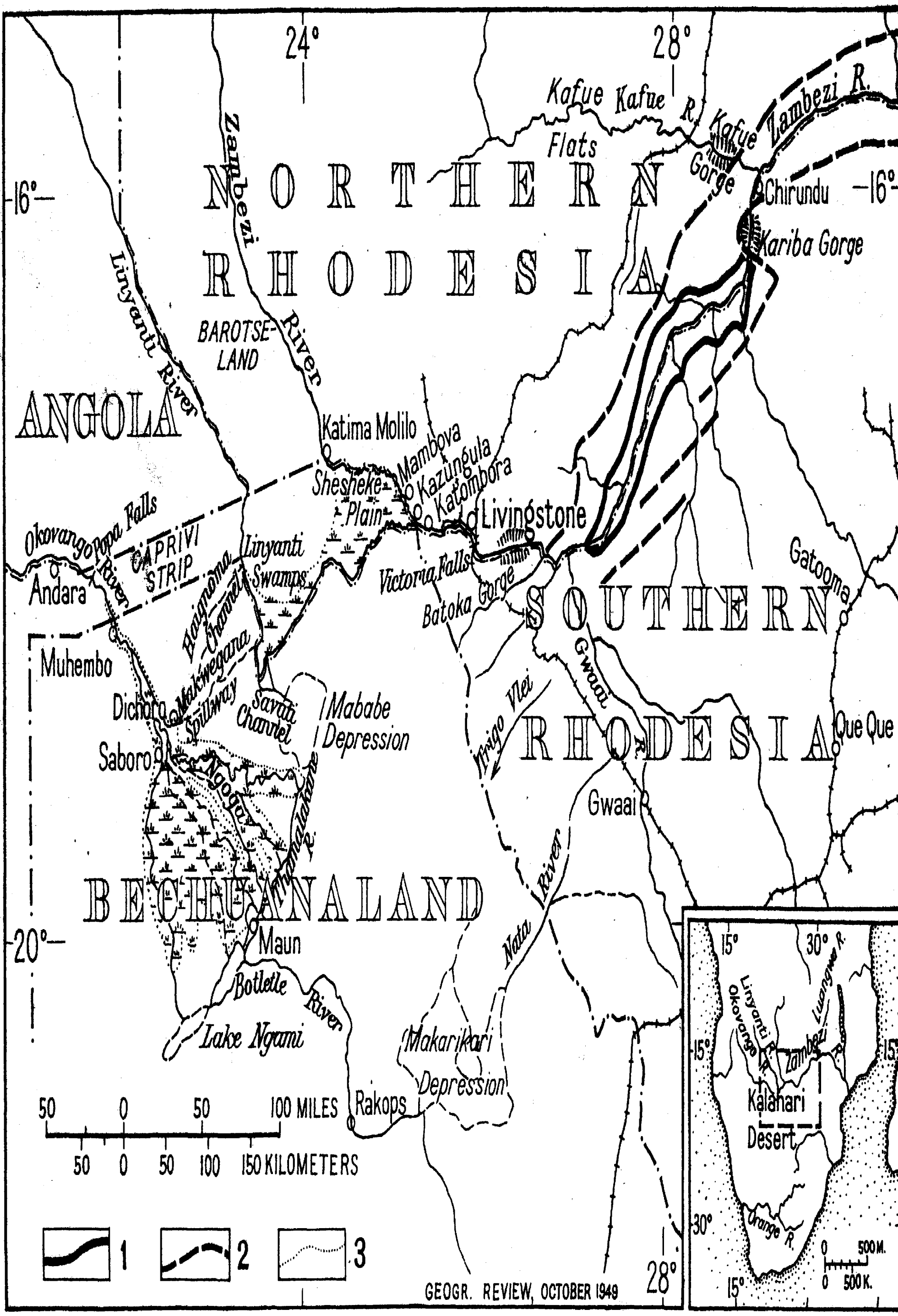

FIG. 1—Sketch map of Zambezi-Okovango relationships and the Kariba project. Key: 1, approximate outline of reservoir to be impounded by a 300-foot dam in

end of the trough tract the Zambezi continues eastward and then southeastward across a belt of igneous rocks and then across the marine sediments (Cretaceous to Recent) of the Mozambique Plain.[6]

The Kariba Scheme

The character and significance of the Kariba gorge now become apparent. In the trough tract the floor of the trough is formed mainly of Karroo sediments—sandstones, grits, and shales of the Stormberg (Triassic) period—but comparatively small fragments of Batoka basalt and Umkondo (Waterberg) quartzite have also been faulted down in the valley floor. Where the river cuts through these more resistant rocks, it forms minor gorges. At Kariba, however, the river passes from its open valley in the Karroo floor and enters a gorge cut in a zone of highly resistant paragneissic rocks[7] which project westward into the trough (Fig. 3).

In the Kariba gorge the Zambezi narrows in places to less than a hundred yards, and its depth at low flow is in places more than 80 feet, as compared with depths of about 10 to 15 feet above the gorge. Through its length of 17 miles the river bed in the gorge has a gradient averaging only about 1 in 31,000 according to surveys made by J. L. S. Jeffares.[8] According to H. W. H. Wallis, a dam 290 feet high in this gorge would have a maximum storage of about 80 million acre-feet, the working head for power use being about 270 feet.[9] It is estimated that for the generation of 750,000 kilowatts the required drawoff would be 20 million acre-feet a year, equivalent to a flow of 27,630 cusecs (cubic feet per second).

The question whether the Zambezi is capable of supplying such a volume of water has been under investigation in recent years. Discharge records at Livingstone,[10] a few miles above Victoria Falls, show that for the period 1924–1925 to 1947–1948 the total seasonal discharge varied from a minimum of 17 million acre-feet in 1928–1929 to a maximum of 42 million in 1947–1948,

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[6] For a description of these regions, and also of most of the other areas discussed in this paper, see J. H. Wellington: A Physiographic Regional Classification of South Africa, *South African Geogr. Journ.*, Vol. 28, 1946, pp. 64–86.

[7] Metamorphosed sedimentary rocks of the Lomagundi (pre-Cambrian) system, the more resistant being quartzites, slates, and lavas.

[8] See R. W. Talbot: Kariba Gorge, *Libertas*, Vol. 7, No. 8, 1947, pp. 32–43.

[9] Central African Council Paper (Zambezi Conference), April, 1948, by the Director of Irrigation of Southern Rhodesia, Salisbury. In a letter dated May 3, 1949, Mr. Wallis says that a survey just completed shows that a 300-foot dam at Kariba would form a lake extending nearly to the confluence of the Gwaai and the Zambezi—a distance of 185 miles.

[10] Central African Council Paper, Appendix 111a. Most of the following hydrographic information relating to the Zambezi and the Kafue is taken from this source. "Seasonal" here refers to the 12-month period October–September, which, in Southern Rhodesia, is designated a hydrographic "season."

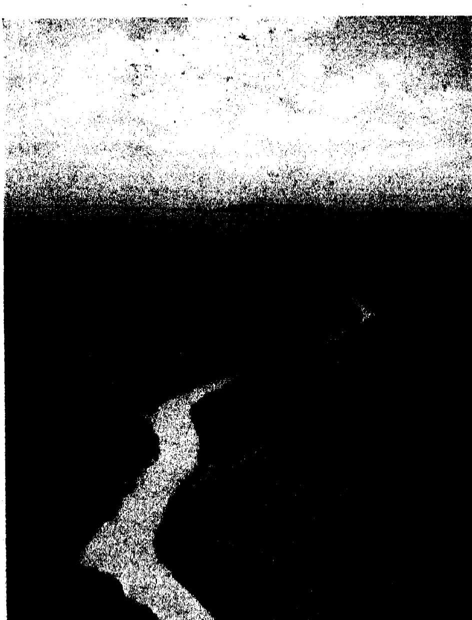


FIG. 2—Bridge across the Zambezi at Chirundu. (Photograph by Aircraft Operating Co. of Africa [Pty.] Ltd.)
FIG. 3—The Kariba gorge of the Zambezi River. (Photograph by Aircraft Operating Co. of Africa [Pty.] Ltd.)
FIG. 4—Part of the Kafue gorge. (Photograph by Aircraft Operating Co. of Africa [Pty.] Ltd.)

with a mean for the period of 25 million. At Kazungula, just below the confluence of the Linyanti and Zambezi, during the highest flood (April 7, 1948) a flow of 194,468 cusecs was gauged; the minimum flow (December 11, 1947) was 9950 cusecs. At the Chirundu bridge, 35 miles below the Kariba gorge (Fig. 2), gaugings during five seasons (1937–1938, 1943–1945, and 1946–1948) gave discharges ranging from 31.6 to 48.1 million acre-feet.

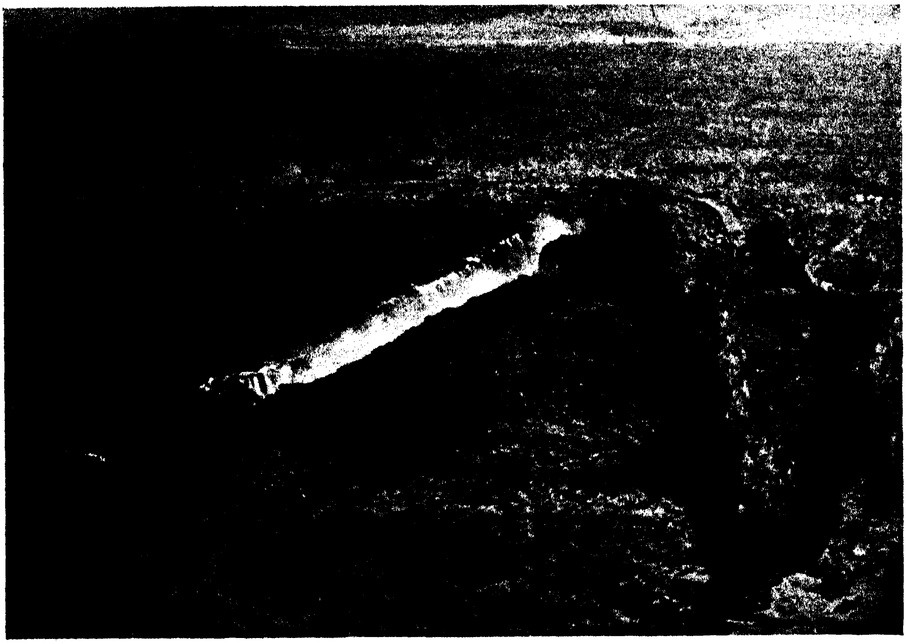


FIG. 5—Victoria Falls, where the Zambezi enters the Batoka gorge.

The maximum flow at Chirundu during the period was 338,500 cusecs (March 18, 1939), and the minimum 7889 cusecs (November 8, 1946). Analyzing the rainfall and runoff records and the correspondence between the Livingstone and the short-period Chirundu records, Wallis concludes that it is only safe to assume an increase of 5 million acre-feet between Livingstone and Kariba.

The Zambezi, however, is by treaty[11] an international river, and to avoid difficulties on this account it has been suggested that perhaps the Kafue River, entirely a Northern Rhodesian stream, might offer advantages for power production comparable with those of the Zambezi at Kariba.

Rising also in the Benguela-Katanga watershed, the Kafue at first flows southwestward, appearing to be making for the Zambezi in the Sesheke

[11] Between Great Britain and Portugal, June 11, 1891 (see Sir E. Hertslet: The Map of Africa by Treaty, 3rd edit., London, 1909, Vol. 3, p. 1022).

plain tract. However, it turns abruptly eastward along the Karroo-floored Kafue flats[12] and, crossing the northern escarpment of the Zambezi trough through a double gorge, reaches its confluence with the Zambezi a few miles below the Chirundu bridge. The Kafue gorge in the escarpment has never been explored on the ground, but from the air (Fig. 4) there appear to be considerable possibilities for power development, the fall in the gorge being about 1500 feet in 25 miles. Gaugings made near the railway bridge above the gorge during the period 1917–1918 to 1947–1948 show a seasonal discharge ranging from 1.26 million acre-feet (1923–1924) to 11.39 million (1947–1948), with a mean of 4.0 million,[13] that is, only about one-ninth of the Zambezi mean flow of 36 million acre-feet at Chirundu.

The Kariba scheme thus holds by far the greater potentiality. Electric power from such a project is needed in Northern Rhodesia especially for the copper mines and for the development of iron-ore deposits. In Southern Rhodesia, with vast reserves of chrome ore in the Great Dyke and rich iron ores in the Que Que area, power at 0.15*d.* a unit would make it possible to produce annually 500,000 tons of pig iron or steel billets and 50,000 tons of ferrochrome at a cost far below the present cost of these commodities in Britain. If these enterprises should absorb 250,000 kilowatts, there would still be sufficient power left for the expanding cotton manufacturing industry at Gatooma, for the gold mines, and for the general industrial and agricultural development of the colony. A further benefit from the Kariba dam would be the availability of water for irrigation in the floor of the valley, when it has been rid of malaria and the tsetse fly.

These potentialities are now under detailed investigation, and it seems probable that the surveys may be completed during the next five or six years.

The Northern Kalahari

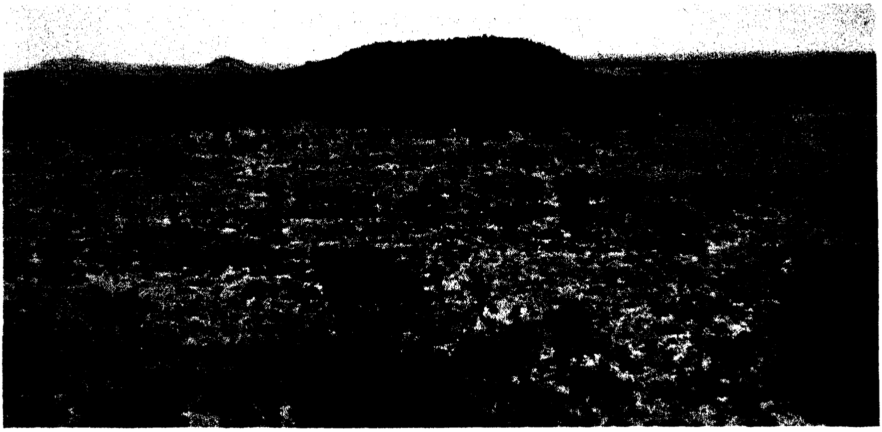
Meanwhile the northern Kalahari has been under scrutiny, mainly from two angles: the provision of a railway route from Southern Rhodesia to the west coast[14] and the development of irrigation.

The construction of a railway across the northern Kalahari presents no technical difficulty, but the project has been complicated by the political status of the terminal area in mandated territory. The proposed route, moreover, would require resiting to bring it nearer the Okovango delta if the developments suggested in this paper should be adopted.

[12] See F. Dixey: The Geomorphology of Northern Rhodesia, *Trans. Geol. Soc. of South Africa,* Vol. 47, 1944, pp. 9–45.

[13] According to H. W. H. Wallis. See reference in footnote 9.

[14] J. L. S. Jeffares: Report on the Rhodesia-Walvis Bay Reconnaissance Survey, Salisbury, Southern Rhodesia, 1932.



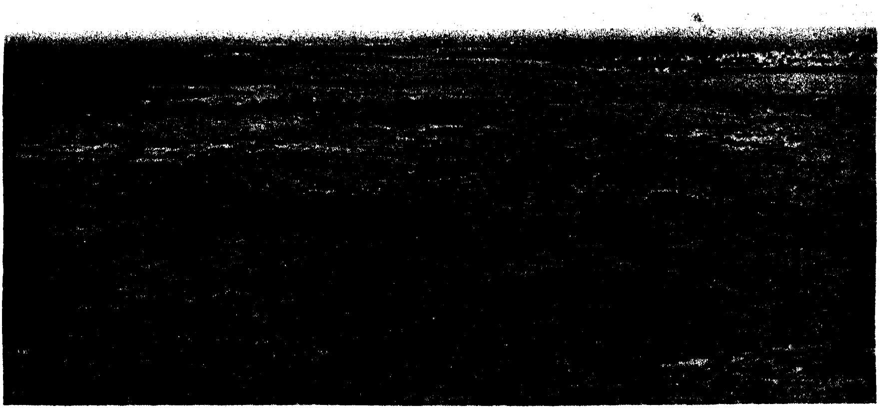


FIG. 6—Hills of resistant Ventersdorp lava protruding through the Kalahari sands north of the Mababe depression. These are rare landmarks in the monotonous sand veld.

FIG. 7—The Linyanti River meandering at the southern margin of the Sheshеke plain. The gradient here is 2½ inches per mile.

FIG. 8—The Makwegana spillway near the Linyanti swamps.

To understand the proposals for irrigation it is necessary to keep in mind the hydrographic relationships of the area, which are somewhat complicated by the nature of the Kalahari surface.

Three rivers are involved: the Zambezi, the Linyanti, and the Okovango. These rivers enter the slight hollow in the Kalahari sand veld generally known as the Ngami depression, which extends from Lake Ngami in the south to the Shesheke plain in the north. Schwarz considered this depression to be the former basin of the "Greater Ngami" lake,[15] but the absence of lacustrine deposits led Du Toit to deny the correctness of this supposition.[16] The southeastern margin of the Ngami depression is not sharply defined, but it is marked by outcrops of the sub-Kalahari rock surface in small quartzite and lava hills southeast of Lake Ngami and east of the Linyanti swamps (Fig. 6) and by sand ridges, probably conforming largely to the underlying rock surface.

The Zambezi, as we have seen, enters the Ngami depression at the Katima Molilo rapids, spreads out in flood over the Shesheke plain, and leaves the depression at the Mambova rapids.

The Linyanti (known also as the Cuando or the Chobe River) has not exposed the sub-Kalahari rock floor. It rises in the sand veld in Angola and flows toward the depression, where its floodwaters, obstructed by the sand ridges referred to above, flow to the Zambezi, clearing the Mambova basalt bar at the Kasane rapids seven miles above the Linyanti-Zambezi confluence. In the flood plain above the Kasane-Mambova rock bar (Fig. 7), the waters of the two streams mingle, the Zambezi waters passing by numerous *kassaias*, or swamp channels, into the Linyanti marshes, later to drain back to the Zambezi in the Linyanti channel. The Linyanti is by far the smallest of the three rivers entering the Ngami depression; its flow has never been gauged, but it is estimated to be of the order of 2½ to 3 million acre-feet a year.[17] An interesting feature is the old—now dry—channel that links the river with the Mababe depression. This, the Savuti channel, with a southern and northern outflow from the Linyanti swamps, must certainly have been the old lower course of the Linyanti.

The Okovango (Cubango in Angola) rises in the Angola Plateau, where the annual rainfall, most of it summer rain, exceeds 50 inches. For the lower 800 miles of its course it flows across the Kalahari formation, except for a

[15] E. H. L. Schwarz: The Kalahari or Thirstland Redemption, Cape Town and Oxford [1920].

[16] [A. L. du Toit:] Report of the Kalahari Reconnaissance of 1925, Union of South Africa Dept. of Irrigation, Pretoria, 1926.

[17] L. A. Mackenzie: Report [of the Director of Irrigation] on the Kalahari Expedition, 1945, Pretoria, 1946, p. 6.

20-mile stretch, ending at Popa Falls, where it has been superimposed on ancient (Waterberg) quartzite. The only large affluent normally contributing to its volume is the Cuito, on its left bank. The right-bank affluents may be considered dead or "fossil" rivers: now they rarely, if ever, contribute to the flow of the main stream.

At Popa Falls the river enters the Ngami depression and proceeds to widen out into swamps which at Dichoro, near the southern end of this "sleeve" tract, are about seven miles wide. Here the anastomosis, which has begun in the sleeve, develops into a delta formed by four main distributaries, which flow to the arc of the delta, the Thamalakane River, where the drainage is blocked by a low sand rise.

The Thamalakane River (Fig. 11),[18] as might be expected, has an extremely low gradient; in the southwest, where it meets a former outflow from Lake Ngami, its gradient is of the order of 1 in 30,000. In the northeastern part the gradient is reversed, so that very high floodwaters have in the past flowed northeastward toward the Mababe depression, the floor of which lies about 50 to 80 feet below the general level of the surrounding sand veld. Apparently, however, this flow from the Thamalakane arc now no longer occurs, for even in the exceptionally high flood of 1925 water did not reach the depression.

About 35 miles from Lake Ngami, which lies at the southern corner of the delta and is now being invaded by thornbush, the Thamalakane continues its course, as the Botletle River, to the Makarikari depression, the lowest part of the northern Kalahari.[19] This depression also receives floodwater regularly from the Nata River (Fig. 9) to the northeast, and from the air it appears to be the terminus of the Trigo Vlei drainage from the sand veld of western Southern Rhodesia. The Makarikari depression is a great natural sink, containing water only after heavy floods in the rivers that empty into it (Fig. 10).

Before considering the economic potentialities of the area it will be of value to examine briefly the hydrographic relationships of the Okovango-Linyanti-Zambezi basins within the Ngami depression. The Linyanti swamps are, of course, now connected with the Zambezi by a more or less continuous channel, which, however, in the dry season is very small upstream from the Sesheke plain (Fig. 1). The connection of the Okovango delta with the

[18] For its various local names and those of the other drainage lines see A. G. Stigand: Ngamiland, *Geogr. Journ.*, Vol. 62, 1923, pp. 401–419. The accompanying map, 1 : 1,500,000, follows p. 476. For a still more detailed map of the same area, see "Sketch Map of Ngamiland . . . and Ghanzi," route traverses executed by A. G. Stigand, 2 sheets, 1 : 500,000, *Geographical Section, General Staff, No. 2988,* 1925.

[19] This depression was approximately surveyed in 1929 by B. E. H. Clifford (A Reconnaissance of the Great Makarikari Lake, *Geogr. Journ.*, Vol. 75, 1930, pp. 16–26).

FIG. 9—The Makarikari depression from the air, showing the Nata River entering its northeastern corner.

FIG. 10—The Makarikari depression, showing the construction of a dry-weather road from blocks of calcrete.

Linyanti swampland is effected only at rare intervals during very high floods. The Haignoma channel[20] apparently no longer carries water, the present connection being made along the Makwegana spillway, a channel which is ill-defined near the head of the Okovango delta but which becomes very clearly defined near the Linyanti (Fig. 8).

A precise traverse through the Linyanti swamps[21] shows a gradient ranging from 0.14 to 0.76 of a foot to the mile. The altitude of low-water level (July–August, 1925) at the southern Savuti intake is 3099 feet above sea level. Between the Linyanti swamps and the head of the Okovango delta no precise leveling has been done, but Jeffares has determined the height of flood level in the main (Ngoga) channel at about 22° 40′ E. as 3177 feet, with a hydraulic gradient in the delta of approximately one foot to the mile.[22] This gives the flood outlet to the Makwegana spillway at the head of the delta an approximate height of 3201 feet, so that in the 80 miles along the Makwegana the fall to the Linyanti swamps is a little more than 100 feet. The present process is therefore scarcely in doubt, although it may be extremely slow. The Okovango is being beheaded at Dichoro as the Linyanti, formerly flowing into the Mababe depression, has been captured by the Zambezi at the present northern Savuti intake.

Northern Kalahari Schemes

The presence of the Zambezi and the swamps so near the "Kalahari Thirstland" prompted E. H. L. Schwarz[23] to suggest diverting the waters of the Linyanti into the Mababe depression by a dam across the swamps. The water so diverted was expected to flow along the channel of the Thamalakane into the Botletle Valley, filling the Makarikari depression and creating an overflow southward into the Orange River Valley. The climatic and other benefits which could be expected to accrue to the Union of South Africa from such a development led to the dispatch, in 1925, of the Du Toit reconnaissance party to test the validity of the "Schwarz scheme." It was found that a dam at the proposed site was impracticable and that, in any case, the waters of the Linyanti were quite insufficient for any scheme involving the irrigation of the Botletle Valley. Du Toit estimated that the only source of water adequate for such a purpose was the Zambezi itself, and he suggested

[20] Franz Seiner: Ergebnisse einer Bereisung des Gebiets zwischen Okawango und Sambesi (Caprivi-Zipfel) in den Jahren 1905 und 1906, *Mitt. aus den Deutschen Schutzgebieten*, Vol. 22, 1909, pp. 1–111; reference on p. 60.

[21] Du Toit, *op. cit.*, Plate II.

[22] Mackenzie, *op. cit.*, p. 11.

[23] *Op. cit.*

FIG. 11—The Thamalakane River near Maun.
FIG. 12—A channel near the end of the Okovango delta. In the background, dense mopane forest.

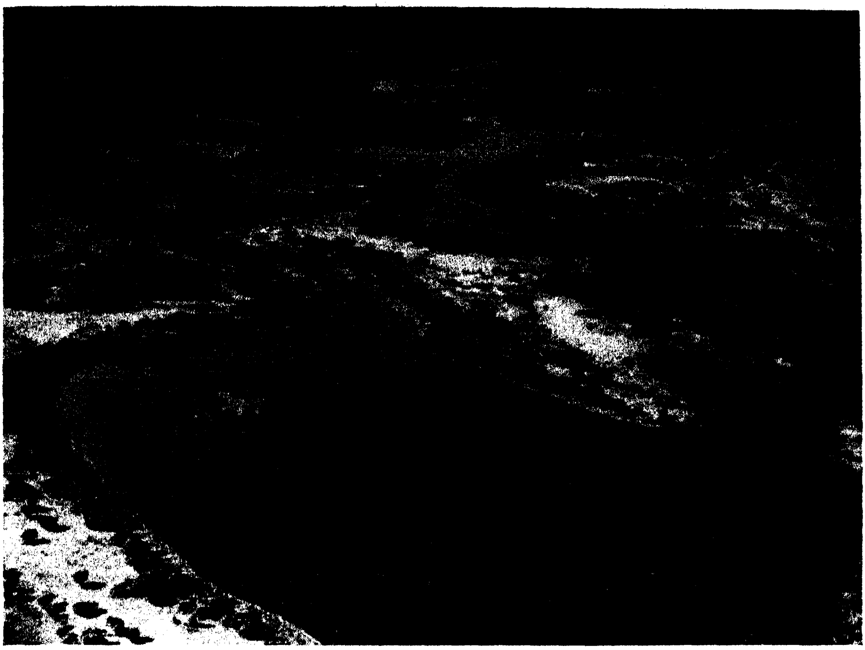


FIG. 13—A typical view in the swamps of the Okovango delta.
FIG. 14—A typical reed swamp at the head of the Okovango delta.

Katombora as the only suitable place for a dam. By impounding 20,000 out of the Zambezi mean flow of 38,000 cusecs, a lake would be created covering the Linyanti swamps and the Mababe depression and having an area of 4600 square miles. The outflow of this lake along the Thamalakane and Botletle Rivers would provide sufficient water for the irrigation of half a million acres in the Botletle Valley.

The Katombora scheme is undoubtedly practicable, but it has never been implemented, for two main reasons: first, the flow of the Zambezi over Victoria Falls would be too greatly reduced; and, second, the reaction to irrigation of the Kalahari soils, with their calcrete subsoil, has always been a doubtful factor. And now the Kariba proposal, if it is adopted, must lead to the final abandonment of the Katombora scheme, for Kariba demands the whole Zambezi discharge.

The Okovango Scheme

After examining the area by road and by air it seemed to the writer that the greatest potentiality in the northern Kalahari lay with the Okovango itself rather than with the Linyanti or the Zambezi. The following facts are stated in support of this view.[24]

The regimen of the Okovango is generally similar to that of the Zambezi: a late-summer flood, mainly from the rainfall on the Angola Plateau, followed by a steady fall in water level until the following early summer. In the 15 years of gauging records at Muhembo, a few miles south of the Bechuanaland border, the highest flood level has occurred between January 24 and May 8, and the lowest flow between September 30 and November 30. The average high flow of the river approximates 33,000 cusecs, the low flow 6000 cusecs. The average for the year is about 14,000 cusecs, equivalent to an annual discharge of 10 million acre-feet. From Stigand's map[25] it is evident that the present and former flooded areas slightly exceed 5000 square miles or 3 million acres.

During the last half century the drainage of the western half of the delta has been decreasing,[26] and the lower course of the westernmost distributary is now completely dry. Choking of the channels by overgrowth of papyrus, by abandoned papyrus rafts, by the making of hippo breeding pools (*madiba*), and by the deliberate action of hostile chiefs is held mainly responsible. At

[24] For a more detailed discussion see J. H. Wellington: A New Development Scheme for the Okovango Delta, Northern Kalahari, *Geogr. Journ.*, Vol. 113, 1949, pp. 62–69.

[25] Sketch Map of Ngamiland . . . and Ghanzi (see footnote 18, above).

[26] C. F. Rey: Ngamiland and the Kalahari, *Geogr. Journ.*, Vol. 80, 1932, pp. 281–308.

present the main drainage line is the Ngoga channel and its branches. This channel is also choked by papyrus in one area. Its overall hydraulic gradient is about 1 in 5000.[27]

The scheme suggested, on the basis of these facts, involves the isolation of the western part of the swamp by the construction, near the head of the delta, of a low mud dike or embankment about 15 miles long. The swampland so isolated can be irrigated from a canal leading out from the river at the natural weir of Popa, slightly raised by a low concrete reinforcement. The canal would have a head of about 30 feet at Saboro, giving it command of the drained swampland. Excess floodwater could be drained through the enlarged Ngoga channel and the deepened Thamalakane to the Botletle and so to the natural sink of the Makarikari depression.

So far as soil is concerned, no large-scale investigations have been made, but trial pits sunk by the 1945 Kalahari Expedition[28] revealed a six-inch surface layer of black soil underlain by white sand passing into yellowish clay at a depth of three or four feet.

There seems to be no other place in Africa where so much agricultural development is possible at so little cost, and the success of the French in the swamps of the upper Niger shows what planning, engineering skill, and sound irrigational practice can accomplish in terrain of this character.[29]

One looks forward to the time when the trans-Kalahari railway will not only connect Southern Rhodesia with the west coast but will also serve a great food-producing area of two million acres, now only the playground of crocodiles, hippos, and fish hawks.

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[27] Mackenzie, *op. cit.*, p. 11.

[28] Mackenzie, *op. cit.*, p. 15.

[29] See Jean Gabus: La colonisation de la boucle du Niger, *Bull. Soc. Neuchâteloise de Géogr.*, Vol. 51, No. 2 [N.S. No. 3], 1945, pp. 1–41; and *Geogr. Rev.*, Vol. 37, 1947, pp. 150–151.

IRRIGATION AND LAND USE IN ZEINIYA BAHARI, UPPER EGYPT

DOUGLAS D. CRARY

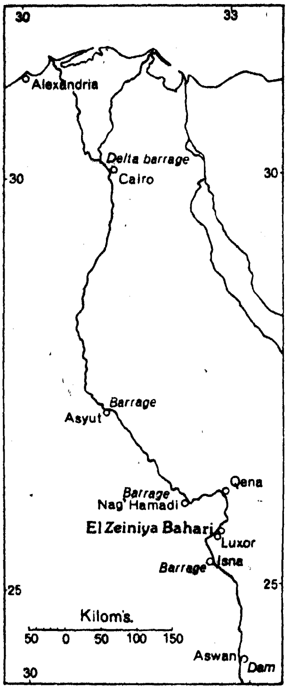

FIG. 1

PRESENT-DAY Egyptian agriculture is dependent on three types of irrigation: the basin system, characterized by an annual flooding of the land; the perennial system, based on diversion dams and constantly flowing canals; and the lift system, which in one form or another is widespread throughout cultivated Egypt but which contributes relatively little to the total amount of arable land.[1]

Within the past fifty years or so the population of agricultural Egypt has virtually doubled, and the increased pressure of population on a relatively nonexpansible cultivated area has presented a serious problem. One reflection of this may be seen in the gradual shift from the ancient one-crop basin system of irrigation once prevalent throughout the country to the more modern perennial method capable of producing more than one crop a year; at present only about one-fifth of the total cultivated area remains under the basin system.[2] The change-over is based, of course, on a more effective year-round utilization of the waters of the Nile, and further progress in that direction holds the hope for future agricultural expansion.

Associated with each of the two major irrigation systems are characteristic crop rotations, methods of tillage, and seasonal activities. Since the Nile is either the immediate or ultimate source of all water used, its regimen and the prevailing irrigation method determine the land use in any given area.

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[1] See H. E. Hurst: A Short Account of the Nile Basin, *Egypt, Ministry of Public Works, Physical Dept. Paper No. 45,* Cairo, 1944, pp. 48–59.

[2] H. E. Hurst and P. Phillips: The Nile Basin, Vol. 1, General Description of the Basin, Meteorology, Topography of the White Nile Basin, *Egypt, Ministry of Public Works, Physical Dept. Paper No. 26,* Cairo, 1931, pp. 21–22; *idem:* The Nile Basin, Vol. 5, The Hydrology of the Lake Plateau and Bahr El Jebel, *ibid., No. 35,* 1938, pp. 3–4.

➤ DR. CRARY is assistant professor of geography at the University of Michigan. The present article is a result of field work undertaken in the spring of 1948 as a part of an extended reconnaissance survey of the Near East.

This is well illustrated in Zeiniya Bahari, a small farming community of Upper Egypt, where both the basin and the perennial systems of irrigation are used, supplemented in each case by the lift system.

The village of Zeiniya Bahari lies on the right bank of the Nile, wholly within the flood plain, and extends from the river to the railroad that crosses the central part of the valley flat (Fig. 2). Administrative changes in 1899 resulted in the separation of Zeiniya Bahari from Zeiniya Qibli, the next village to the south. The eastern boundaries of both were then fixed to conform to the new railroad that had been pushed southward from Nag' Hamadi after the construction in 1897 of the railroad bridge across the Nile at that point. Zeiniya Bahari is now one of 24 similar villages comprising Markaz Luxor, Mudiriyet Qena, and has a population of some 5000.

The Physical Setting

In the landscape picture of Zeiniya Bahari the natural features are subordinate to the works of man. The surface of the flood plain has been smoothed by centuries of tillage and the controlled deposition of silt effected by basin irrigation. The soil is Nile mud with little sand content.[3] Temperatures permit a year-round growing season. The summers are hot, the winters not too cool to necessitate special agricultural adjustments, and the periods of transition are short. The annual rainfall is so scanty that it is not even recorded at the several weather stations in the vicinity; water for crops is obtained entirely from the Nile. There is no natural vegetation worthy of the term.

Regimen of the Nile

The annual flood of the Nile is the most important single natural phenomenon affecting land use in the entire valley. Even this is partly dominated by man and has been capitalized on in the interest of irrigation. In Zeiniya Bahari, in a normal year, the Nile begins to rise in the second week of August and reaches full flood by the end of the month. The area irrigated by the basin system is covered with water at this time. After the peak the flood takes two months to subside. The river level continues to lower, however, until the following April, when it reaches the lowest stage. From then until the approach of the next flood the level is kept high enough by the release of water from the Aswan Reservoir to ensure adequate supplies for land irrigated by the perennial method.[4]

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[3] John Ball: Contributions to the Geography of Egypt, Ministry of Finance, Survey and Mines Department, Cairo, 1939, pp. 32–33.

[4] Hurst and Phillips, The Nile Basin, Vol. 1, *loc. cit.*

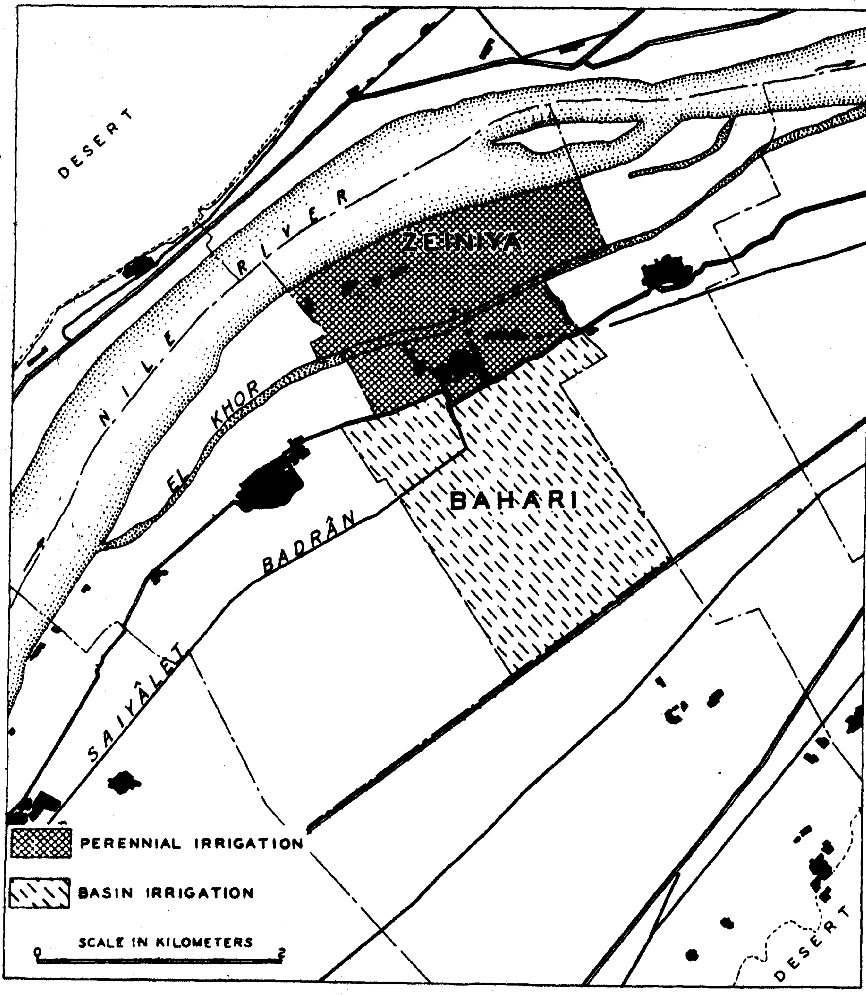

FIG. 2—Areas of basin and perennial irrigation within the village limits of Zeiniya Bahari.

THE BASIN SYSTEM OF IRRIGATION

In Zeiniya Bahari the land irrigated by the basin system lies between the old village road and the eastern boundary (Fig. 2); it is perhaps two-thirds of the area of the village. This area is slightly lower than that between the road and the river, where the deposition of silt has been somewhat greater. The lower area is divided by earth embankments into basins of various sizes and shapes. In form and arrangement they are similar to rice paddies of comparable size in the flood plains of the great rivers of Southeast Asia, and they are flooded in a similar way.

The basins of Zeiniya Bahari are filled at floodtime by a canal system

originating at the Isna Barrage, some 65 kilometers upstream (Fig. 1). The Isna Barrage was built in 1912 for the purpose of maintaining a sufficiently high river level at floodtime to ensure water for the basins downstream as far as Nag' Hamadi, particularly in years of subnormal flood.[5] Before its construction, much of the basin area of Zeiniya Bahari had to be left fallow in low-level flood years because of insufficient water. The small amount of water then available was run into temporary subbasins within hastily constructed embankments, so that at least some crops could be grown. The construction of the Isna Barrage has eliminated the threat of famine from too little water at times of low flood.

The water diverted into the basins of Zeiniya Bahari by the Isna Barrage takes about 20 days from the beginning of the flood period to cover the land completely. It lies about a meter deep in the basins until the latter part of October—about 45 or 50 days. It is then drained off by a series of escape canals into the Nile, which meanwhile has subsided considerably; the draining also takes about 20 days. A deep, thick mud remains, in which the winter crops are sown. No more water is received in the basins until the next flood, in the following August. Thus only one crop a year is obtained from most of the basin land.[6]

Crop Regime under Basin Irrigation

Planting takes place in the last week of October and the first weeks of November. The first crops sown in the mud left by the receding waters are forage crops, chiefly white clover (*bersîm baladi; Trifolium alexandrinum*), flat peas or chickling vetch (*gilban; Lathyrus sativus*), and fenugreek (*ḥilba; Trigonella foenum-graecum*) (Fig. 3). The seeds are sown broadcast by hand and are turned into the soft mud by dragging with a piece of wood, also by hand. Ten or fifteen days later, when half dry and firm enough to support work animals, the remaining land is plowed. This land is immediately put into food crops, the total area of which is somewhat greater than that given to forage crops. The principal food crops, also sown broadcast by hand, are wheat (*qamḥ*), barley (*sha'ir*), cowpeas (*lûbiya; Vigna sinensis*), lentils (*'ads; Ervum lens*), and a small quantity of safflower or bastard saffron (*qurṭum; Carthamus tinctorius*), used both for the orange dye obtained from the blossom and for the oil from the seed.

One important feature of land use in the basin area is the rotation of legumes and cereals. Most of the crops raised in Zeiniya Bahari are one or

[5] Ball, *op. cit.*, p. 8; Hurst and Phillips, The Nile Basin, Vol. 5, p. 9.

[6] See Hurst and Phillips, The Nile Basin, Vol. 5, pp. 3–4.

the other, and the acreages are about the same. The legumes, of course, are mostly herbaceous forms and are both forage and food crops. Fields put into clover, flat peas, fenugreek, cowpeas, lentils, and so on in one year are planted in wheat, barley, and sorghum the next. Little or no manuring is done. The process has not changed since ancient times. Combined with the annual replenishment of the soil by the deposition of flood-borne silt, this legume-cereal rotation is largely the cause of the continued maintenance of soil fertility in the basin area.

For the next three months, from planting to harvest, there is relatively little activity in the basin area. Most of the farming is now taking place in the perennially irrigated land. The soil in the basins dries out and begins to crack (Fig. 11). From the end of February on, the cracks become wide enough to make footing for livestock insecure.

The harvest begins about the middle of February with the first cutting of the forage crops. Several weeks later, toward the end of March, the barley, cowpeas, and lentils are harvested. The wheat harvest is in April. The stalks are piled at a central point, and the grain is threshed and winnowed there, then stored or marketed. Stubble left in the fields for grazing after the first cutting and still unconsumed is also brought in at this time. The winter growing season is over, the harvests are in, and the tax collector is just around the corner.

Harvesting is done entirely by hand; the sickle is the universal tool. Teams of laborers, ten or twelve abreast and each man armed with a sickle, cut a swath perhaps 10 meters wide through the standing crop (Fig. 5). Camels, donkeys, and human beings carry the crop to the storage or threshing areas. Two or three teams working side by side often compete to see which can travel the farthest in a day; each team is supervised by a foreman, who shouts encouragement. Such primitive harvesting requires many hands and an abundance of time, but there seems to be no lack of either.

Specialized Land Use in the Basin Area

An interesting aspect of the harvest season in Zeiniya Bahari is a simple form of transhumance. It consists of the movement of people and animals from the hamlets in the perennially irrigated area to the fields in the basins at the beginning of the harvest in February and their return when the harvest is over in May. Relatively few people take part, and the distance may be only a kilometer or two. The movement is primarily a function of animal husbandry: it is easier for the farmer to bring his stock to the source of feed in this case than to carry the feed to the animals. The practice is no doubt ancient

FIG. 3—Land use map of northern Zeiniya Bahari.

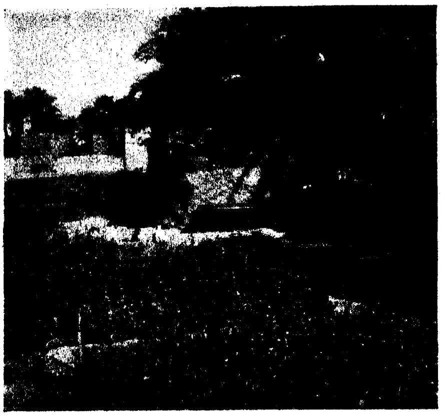

FIG. 4—Typical house in Zeiniya Bahari (plan shown in Fig. 15). Note date palms growing within the walls and thatched part of family quarters.

FIG. 5—Farmers harvesting lentils with sickles.

FIG. 6—Interior of 'ezbah. The low mud wall separates the family quarters from the animal area. (See Fig. 10.)

FIG. 7—A sâqiya—the principal type of lift apparatus for irrigation.

FIG. 8—Entrance to 'ezbah, showing lean-to and type of construction.

FIG. 9—The mud and dung stove in the 'ezbah. It is fired through the opening at lower right; the hole at the side is the oven opening.

and may reflect the original seminomadic character of a part of the population.

The temporary housing unit in the basin area is known locally as an *'ezbah* (Fig. 12). The term is used in its original sense of "encampment," as distinguished from the modern usage denoting the estate of a landed proprietor.[7] The 'ezbahs vary in size according to the number of animals owned. They are nearly square enclosures from 10 to 20 meters on a side (Fig. 10). The walls are palisades of sorghum stalks set into the ground to a depth of 30 to 40 centimeters and bound near the bottom and about halfway to the top with intertwining straw ropes and more stalks. The height of these sorghum palisades is about three meters. The gates invariably face eastward and are guarded by a lean-to in which the head of the family retreats from the sun by day and sleeps at night (Fig. 8). In a corner inside are the family quarters, surrounded by a low mud wall to keep out the livestock. Here are a mud-and-dung oven for baking bread, food and water jars, the minimum of household utensils, and a small covered shelter for the women and children (Fig. 6). The rest of the interior is given over to the stabling of animals at night. These may be a camel or two, cattle, donkeys, goats, sheep, perhaps a buffalo, and a flock of chickens. Water is brought by the women from a near-by *sâqiya* (a lift device; see p. 581) or by a water carrier from a canal. Some food is kept in the 'ezbah, and the supply is replenished from the household stores in the village.

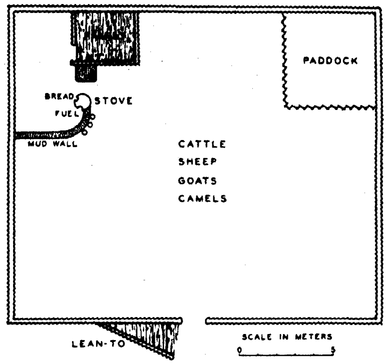

FIG. 10—Plan of typical 'ezbah.

The farmer moves out to his 'ezbah with his family, furniture, and animals at the beginning of the harvest season. The livestock graze progressively over the stubble or are fed with fresh cuttings (Fig. 11). The larger animals are usually tied to a stake, which is moved from day to day to ensure complete and uniform grazing coverage. The smaller animals, such as sheep and goats, are tended by children. A few itinerant ropemakers may be present, twisting palm fibers by hand into cattle tethers, in great demand at this time. Some of the family may take part in the harvesting of crops near by. When the harvest is finished, the farmer returns with his family and

[7] J. Lozach and G. Hug: L'habitat rural en Égypte, *Publs. Soc. Royale de Géogr. d'Égypte*, Cairo, 1930, p. 156.

animals to his permanent house in the village, to spend the hot summer within its cool mud walls, and the 'ezbah is dismantled or burned.[8]

From the first week of May until the next flood subsides in the following autumn there is again little or no agricultural activity in the basin area. A few small plots near the road are irrigated during the summer with water raised from the ground-water table by sâqiyas and support a small amount of sorghum (*dura; Sorghum vulgare*), which must be harvested before the August flood whether ripe or not, but most of the fields lie in dry fallow. The summer period before the coming of the flood is known as the *charaqi* and is characterized by intense heat and drought. Contraction of the soil is at the maximum, and the resulting cracks may reach a width of 10 centimeters and a depth of a meter and a half. The soil is thus aerated to a fairly high degree.[9] At floodtime the water fills the cracks and reduces the entire basin surface to the annual Nile ooze.

The Perennial System of Irrigation

The part of Zeiniya Bahari irrigated by the perennial system lies between the old village road and the Nile (Fig. 2). Its highest surfaces are about a meter and a half above the level of the basins. It consists of that part of the flood plain of the Nile which, without man's interference, would include the natural levees. Until comparatively recently this area was basin land, subject to controlled annual flooding, and its surface has been smoothed out accordingly. Old embankments of the former basin system, used also as protection for the hamlets from inundation, are still found. The old village road itself follows the crest of a high embankment, which turns sharply here and there to deflect the force of the floodwaters and thus lessen the danger of being washed away. This embankment now separates the perennially irrigated area from the basin land.

Although the perennially irrigated area of Zeiniya Bahari is watered the better part of the year, it is not typical of the perennially irrigated lands of Egypt as a whole. In fact, the perennial irrigation system as found in Zeiniya Bahari might better be called the "canal" system, which emphasizes technique rather than time. The usual system of perennial irrigation consists of main canals running parallel to the river, with their take-offs immediately upstream of one of the barrages. The barrages form large weirs that considerably lessen the difference between high and low Nile and supply water to the canal

[8] *Ibid.*, pp. 76–80.

[9] V. M. Mosséri: The Fertility of Egypt, *Internatl. Rev. of the Sci. and Practice of Agric.*, Vol. 4 (N.S.), 1926, pp. 1–9; reference on pp. 5–6.

system during the low stage. From the main canals the water is passed to branch canals, then to distributaries, then to *misqas*, the smallest of the permanent ditches, and finally to the land itself. Regulating devices along the way maintain proper levels and ensure an equable distribution of water throughout the year.[10]

In Zeiniya Bahari the problem of so-called "perennial" irrigation revolves around the condition of El Khor (Figs. 2 and 3), an abandoned channel of the Nile between the road and the river. Before the construction of the Isna Barrage, El Khor was a flowing stream, and the land between it and the Nile was an island. El Khor was then a natural canal, from which water was obtained directly at floodtime and by lift techniques during low water. Since the construction of the Isna Barrage, El Khor fills most years, if the flood is sufficiently high, and the land between it and the river is cultivated. But in the years when water does not enter El Khor, lift irrigation cannot take place, and no crops are raised in this area. Only a narrow strip along the river where water is directly available is cultivated at such times. The land between El Khor and the road, on the other hand, is watered by a branch canal, called Saiyâlet Badrân (Figs. 2 and 3), originating at the Isna Barrage, and true perennial irrigation is carried on. The dependence on the Nile flood is thus greater in the perennially irrigated area of Zeiniya Bahari than in typical areas in Egypt irrigated by this system.

Crop Regime under Perennial Irrigation

While the basin land is being covered with water during the late-summer flood, the perennially irrigated land is being prepared for its fall crops. The hard, sun-dried earth is first broken up with a plow (Fig. 13), then soaked with water from El Khor or Saiyâlet Badrân. As soon as the land has dried out enough, it is plowed a second time. This occurs immediately after the peak of the flood, about the end of August. The area is then sown in maize (*dura frangi; Zea mays*) and sorghum.

These fall or floodtime crops take about three months and a half to mature. During the growing period they are irrigated five or six times with water from El Khor, Saiyâlet Badrân, and the river. A network of ditches, some of which are temporary, supplies both maize and sorghum fields. For maize, the water is simply turned into the furrows between the rows. The sorghum fields are divided into many small compartments by banks a dozen centimeters high, which hold the water in place until it soaks into the ground.

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[10] See Hurst and Phillips, The Nile Basin, Vol. 5, pp. 4–6.

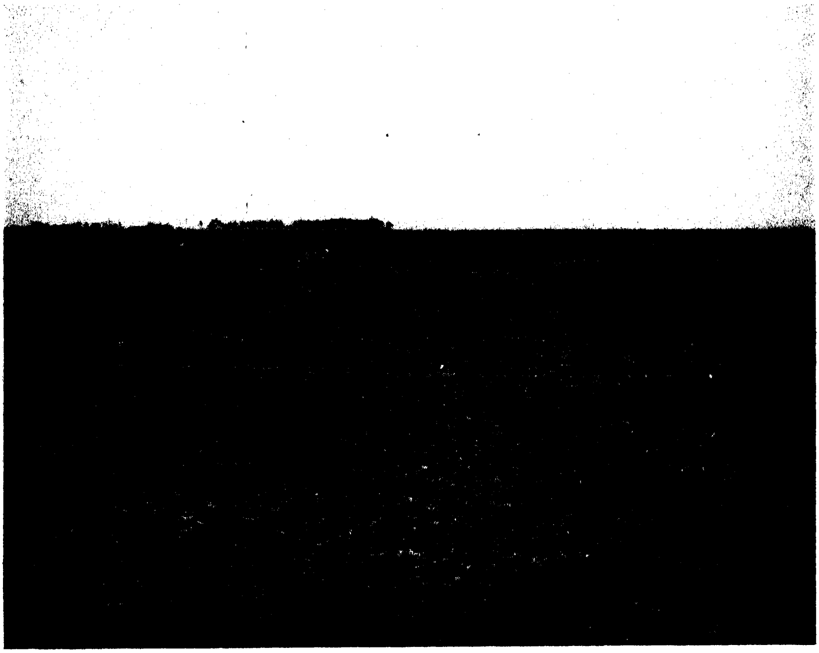

FIG. 11—Basin land during the harvest. The development of mud cracks is well advanced (March, 1948). Tethered cattle are grazing on stubble.

FIG. 12—'Ezbahs in the basin land during the harvest season.

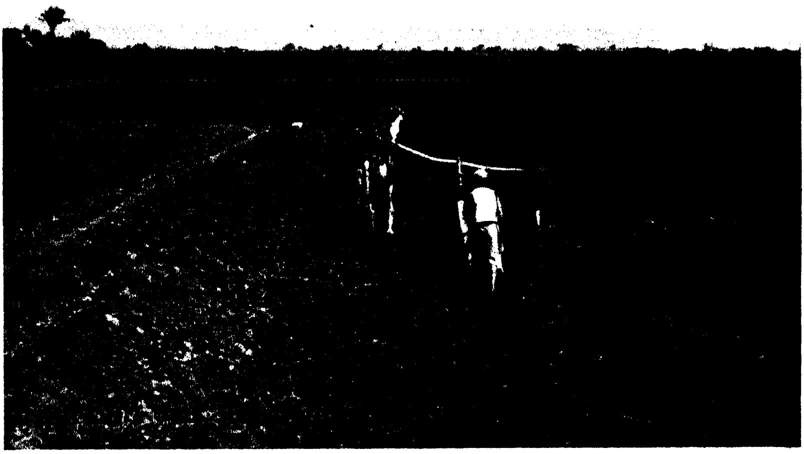

FIG. 13—Plowing perennially irrigated land prior to soaking with water.

FIG. 14—El Khor bearing a stand of wheat during the winter growing season. In the background is a pipe carrying irrigation water from diesel pump in the village.

As the level of El Khor and the river subsides with the receding flood, more and more dependence is placed on lift methods to irrigate the land. Fortunately, as the season advances and becomes cooler, the crops require less water, which compensates somewhat for the increased effort necessary.

The maize harvest takes place about the first of December, about the same time as the planting of food crops in the basin area. It is a very active period. Immediately after the crop is gathered, the fields that carried maize are plowed and planted in winter food crops (Fig. 3)—wheat, barley, and cowpeas. The sorghum is harvested about the middle of December, and the fields are left fallow until the following August.

The winter crops are irrigated during the growing season principally by lifting water into canals; they are ready for harvest about the same time as their basin-area counterparts. El Khor, now empty, is planted in these crops (Fig. 14). The cowpeas are brought in first, in early March, and are followed by barley in the latter part of March and wheat in April. The fields are then left fallow until the coming of the next flood.

The rotation system in the perennially irrigated area thus consists of floodtime maize followed by winter food crops and summer fallow. After the next flood these fields are put into sorghum, which is followed by both winter and summer fallow. In this way, three crops every two years are obtained in the perennially irrigated area of Zeiniya Bahari, in contrast with two and sometimes three crops a year in the perennially irrigated lands of Egypt as a whole.

Along the Nile is a narrow strip of land that is inundated during the flood season. Its winter utilization is similar to that of the basin area (Fig. 3). Clover, flat peas, and fenugreek are sown in the first part of November in the mud left by the subsiding river and receive no water during their growing period. They are harvested at the same time and in the same way as the forage crops in the basin area, and they even support a few ʻezbahs. But, unlike the basins, this strip of land bears a second crop during the summer. This crop is lupine (*tirmis; Lupinus termis*), the seeds of which are esteemed as food. It is irrigated by sâqiyas perched high on the bank above the low summer Nile.

A limited and highly specialized form of land use is the nonirrigated production of watermelons (*baṭṭîkh; Citrullus vulgaris*) on the sand flats of the Nile bottom. This cash crop is planted in early March when the level of the river is approaching its lowest stage. Pairs of rectangular holes, each about a meter long, 30 centimeters wide, and 60 to 80 centimeters deep, are dug about 30 centimeters apart in the moist sand, aligned in typical truck-garden fashion. They are filled with a mixture of sheep manure and sand, and the

watermelon seeds are planted between them. The first stages of growth are comparable to the growth of seedlings in a hotbed. As the watermelon plants mature, the root system penetrates the fertilized zones on each side, and this stimulates a rapid development of fruit. The melons are watered by capillary moisture rising from the water table, only a meter or so below the surface.

Lift Techniques of Irrigation

A consideration of irrigation practices and land use in Zeiniya Bahari would not be complete without specific reference to lift techniques. Their position in the overall economy of the village has been pointed out—principally to supplement the basin and perennial systems. In the basin area a few sâqiyas raise water from the ground-water table to irrigate a small amount of land in summer sorghum. In the so-called "perennially" irrigated area sâqiyas and Diesel pumps lift water from El Khor, Saiyâlet Badrân, the Nile, and the ground-water table to assist in the irrigation of maize and sorghum in the late fall. The winter food crops and the summer lupine along the riverbank are watered almost entirely by lift methods, since the level of the river has lowered beyond the point where water can be poured directly onto the fields.

The sâqiya (Fig. 7) is a homemade mechanical device of ancient origin consisting in principle of two geared wheels about two meters in diameter, one suspended horizontally and the other vertically. As the horizontal wheel is turned by a draft animal, the vertical wheel lifts water by means of jars attached at more or less regular intervals to an endless palm-fiber rope ladder looped over it. When the jars are at the bottom of the loop, they fill from the available source of water, whether an open body or a pool at the bottom of a well. As they pass over the vertical wheel at the top of their course, they spill their contents into a trough, which carries the water away. There are five privately owned Diesel pumps in Zeiniya Bahari, all raising ground water from wells. Even though they are of small diameter, they greatly increase the supply of available irrigation water. The lift from the ground-water table for Diesel pumps and for sâqiyas located on wells is from 7 to 10 meters.

Settlement Patterns and House Types

The perennially irrigated area, being slightly higher than the basin area, is the natural site for permanent settlement, and all the hamlets in Zeiniya Bahari are located there. Settlement consists of four or five compact agglomerations of various sizes (Fig. 2). The largest is a tightly packed mass of dwellings with a maze of narrow, dusty streets. The others have few if any

so-called "streets," access to practically all dwellings being by peripheral paths. House types vary according to the economic status and size of the family. A few dwellings are two-storied and have mud roofs; others have only one level and may or may not have a mud roof. All are constructed of sun-dried mud brick and, if necessary, date-palm timbers. A characteristic

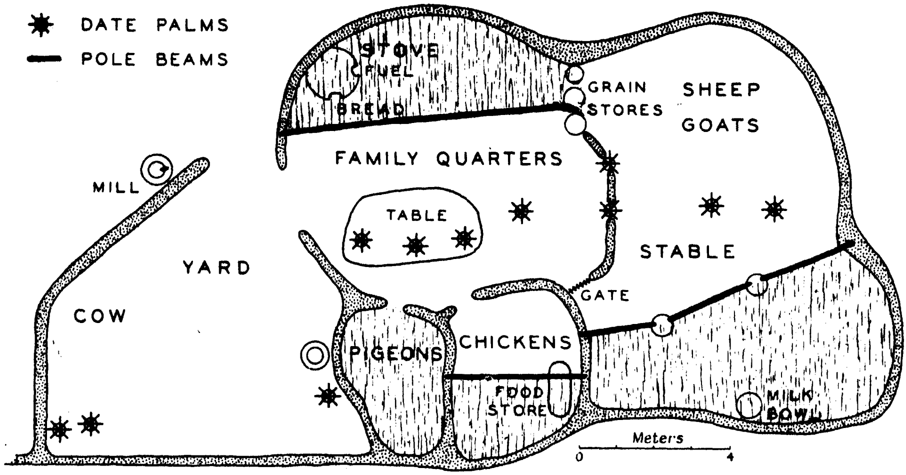

FIG. 15—Plan of a typical house in Zeiniya Bahari.

feature of these agglomerations is a large depression within or adjacent to the built-up area, usually with stagnant water at the bottom. These depressions are the sources of the mud that has been converted into human shelter. The earth gives birth to the mud house and with time and desiccation inevitably gathers it unto itself again.

The house to be described, the sort occupied by the average farmer, is regarded as being most representative of several distinct dwelling forms in Zeiniya Bahari (Figs. 4 and 15). It consists simply of a mud-brick wall about two meters and a half high and 30 to 50 centimeters thick, smeared on both sides with mud plaster. It is roughly rectangular in plan, but the corners are rounded, and the wall bulges according to the arrangement of the "rooms." The few interior partitions are also built of mud brick.

The inside of the house consists of three sections, one each for its human, bird, and animal occupants. The first is occupied by the family. To the left of the door are the mud-and-dung stove and a few straw sleeping mats. To the right is a mud platform about 40 centimeters high, used as a table. To the right of this is the second section, an enclosed area made up of two rooms, one for pigeons, the other for chickens. Ahead, through a light gate, and occupying the entire rear of the house, is the third section, the stable for sheep and

goats. Part of the fence separating the family quarters and the stable consists of large clay jars, about a meter and a half tall and 75 centimeters in diameter, used for storing grain and food.

A noticeable feature of this house is the absence of a solid roof. Only the cooking and sleeping area in the family section, a part of the stable and chicken room, and the entire pigeon room are covered. The roof consists of horizontal sorghum stalks supported by the walls at one end and light pole beams at the other. Woven straw mats are thrown on top of the sorghum thatch. The rest of the interior is not entirely exposed, however, since there is ample shade from the fronds of eight date palms growing within the walls.

To summarize, the agricultural pattern in Zeiniya Bahari points the close relationship between specific irrigation techniques and land-use practices. Behind both lies the determining influence of the Nile, not only as a source of water but also as a regulator of seasonal activity. The annual Nile flood is the big event of the agricultural year. Following it, there is intense activity in both the basin area and the perennially irrigated area, to take advantage of abundant water. As the season advances, the water supply decreases, curtailing agricultural production. The basins yield only one crop, for the most part, during the year. In the perennially irrigated area the land may be used while the basins are submerged, and two crops may be obtained. In both areas the summer sees little agricultural activity, not so much because of the heat as because of the low stage of the Nile. It is the amount and timing of the water supply that are of chief concern, and agricultural adaptations are made accordingly.

THE SHU TAO OR ROAD TO SZECHWAN

HEROLD J. WIENS

Hard are the Ways of Szechuan,
Harder than scaling the sky.

Peaks join on to the heavens,
Scarcely a foot between;
Hollow old firs o'er-drooping
Chasms of depth unseen.
Torrents and cascades rushing
Rage with a stunning roar,
Boulders whirling before them
In thundering caverns pour.

Dangers such as are here . .
Invaders, ah! from afar . . .
Why come to this scene of fear?
Why come to this world of war?
Buttressed on towering rock,
The Hall of Swords ascends.
Thousands can never shock
This Pass, if one defends.

—Li Po, *d. 762*

THUS the famous Chinese poet Li Po[1] describes the Shu Tao or Road to Szechwan and its chief barrier fort, the Chien-ko or Hall of Swords. Romantic though the theme may be for poetic fancy, what is the significance of this road for the geographer?

In the retarded development of China in modern times the poorness of land communications is generally recognized as a fundamental impediment to progress, economic, political, and cultural. An especially important communications line is the Shu Tao, which cuts across the rugged and roughly parallel Tsinling Shan and Tapa Shan. Throughout Chinese history

[1] Translation by W. J. B. Fletcher: A Guide to Chungking, China Information Committee, 1939. Figure 1 (above) is a Chinese artist's conception of the Chien-ko. The road follows the face of the cliff to the right center, passing through the three-storied fort.

➤ Dr. Wiens is an assistant professor in foreign-area studies at Yale University. This article is from his doctoral thesis. He has spent 18 years of residence, travel, and study in China, where he was born.

these ranges have interposed a formidable barrier, climatic[2] as well as topographic, to intercommunication between the two main divisions of China, the dry North and the humid South. The changing role of the transmontane roads spanning the Central Mountain Belt has been intimately related to the historical and geographical evolution of China, a relationship that has continued to the present day.

Two regions of China have made unique contributions to the rise and growth of the Chinese nation. The Wei Ho Valley of Shensi Province is the site of one of the earliest civilizations in the world. It was the cradle of the nation and, until the end of the Han period (A.D. 220), the core of what Chi Ch'ao-ting calls the "key economic area" of China.[3] The Szechwan Basin, the "storehouse of China," adjoining Shensi on the south, has been important in Chinese history for more than 2000 years as what Chi calls one of the two "secondary key areas." It is now by far the most populous province of the republic and one of the richest in natural resources. As Shensi gave birth to the old political and social system of China, so Szechwan has nurtured the new. In the nine years of war with Japan ending in 1945, Szechwan proved to be the salvation of China.

Through the western part of the Central Mountain Belt separating these regions ran the historic Linking-Cloud Trestle Road, Lien-yün Tao, across the Tsinling Shan and the Road of the Golden Oxen, Chin-niu Tao, across the Tapa Shan.[4] Together they constituted the Shu Tao or Road to Szechwan. More difficult ways through these mountains have been used, but for most of the last 2000 years this 430-mile route has been the principal, and for long periods the sole, channel of communication between North China and the rich lands of the Szechwan Basin and the Chengtu Plain and beyond to Kunming and to Lhasa.[5] During recent centuries the importance of this route has declined, and the road has been allowed to fall into disrepair and decay.

Historical Roles of Western Tsinling Shan Routes

Northward from the abrupt descent of the Tsinling Shan stretches the climatically dry but fertile basin of the Wei Ho, composed of alluvial deposits from the surrounding loess hills. South of the divide the humid

[2] "To come to Szechwan in the winter time from the adjoining province of Shensi is to experience a dramatic contrast between the frozen, yellowish land of the Wei Valley and the lush green growth of the Red Basin" (H. L. Richardson: Soils and Agriculture of Szechwan, *China, Ministry of Agric. and Forestry, Natl. Agric. Research Bur. Special Publ. No. 27,* Chungking, 1942, p. 5).

[3] Chi Ch'ao-ting: Key Economic Areas in Chinese History as Revealed in the Development of Public Works for Water-Control, London, 1936.

[4] Feng Hsien Chih (Feng District Gazetteer), 1892, ch'uan 1, pp. 15–23.

[5] Liu-pa T'ing Chih (Liu-pa Subdistrict Gazetteer), 1842, ch'uan 4, pp. 14–19.

landscape of South China suddenly appears and the mountain slopes merge into the subtropical Red Basin of Szechwan. The Wei Ho Basin was the garden plot of Chinese civilization, from which the verdant tendrils of Han culture spread to the north, east, and south. In the rich soils and abundant moisture of the protected Red Basin, the Han culture put forth new shoots, and Szechwan became at an earlier date than other parts of South China a cultural branch of the Wei Ho civilization and a mainstay of the new Han state. To continue the metaphor, the tendrils of this culture that curled and wound south through the mountain belt to Szechwan followed the "Chan-tao" or trestle roads over which the Ch'in rulers of the north had driven to subjugate Szechwan in the third century before Christ.[6]

During the last thousand years the principal route has not changed, though before the Sung dynasty alternative routes through the Tsinling Shan were maintained for courier use. What has fixed this route as the main line of travel since Sung time? Foremost, perhaps, is the fact that the Lien-yün Tao makes the most direct connection with the Chin-niu Tao, the easiest route into Szechwan from the Hanchung Basin. By going as far west as possible on the comparatively level route through the Wei Ho plain and then striking south from Paoki through the Tsinling Shan the traveler avoided the devious and rugged course up the Han Kiang that was necessitated by a crossing of the Tsinling Shan farther east. Moreover, abundant food and comfortable lodgings were to be found on this well-traveled highway, in contrast with the routes which in part follow the river below the Hanchung Basin, where level land for crops is scarce. The approximately 155 miles of mountain road of the Lien-yün Tao between the Wei Ho Valley and the Hanchung Valley is 20–90 miles shorter than other routes through the Tsinling Shan.[7] An older route, which strikes south from Meihsien, the Pao-yeh Tao, is about the same length or a bit shorter but traverses much more difficult terrain. The passes on the Lien-yün Tao are generally lower, only two or three reaching an elevation above sea level of about 6000–7000 feet; on other routes they exceed 7000 feet, and one crosses at 8690 feet.[8]

Naturally, too, the destination in Szechwan influenced the location of the main route. Chengtu, the cultural and political capital, set in the midst of the most prosperous and populous section of the province, caused a

[6] Liu Ting-sheng: Ssu-ch'uan Li-shih (History of Szechwan), Chungking, 1944, pp. 5–6.

[7] Ou Yang-yin: Li-tai Chan-cheng Yü-ti T'u, Ya-hsin Ti-li-she (Historical Atlas of Regions and Wars, Ya-hsin Geographical Society), Wuchang, 1933; P'eng Hsueh-p'ei: Chien-kuo Kai-lun (An Analysis of National Reconstruction), Chungking, 1944; Chung-hua Shu-chü (Chung-hua Book Company): Chung-kuo Ti-li Hsin-chih (New Atlas of China), Shanghai, 1935, Sect. 5, Chap. 9, pp. 201–202.

[8] Sir Francis Younghusband: Peking to Lhasa, London, 1925, pp. 33–38.

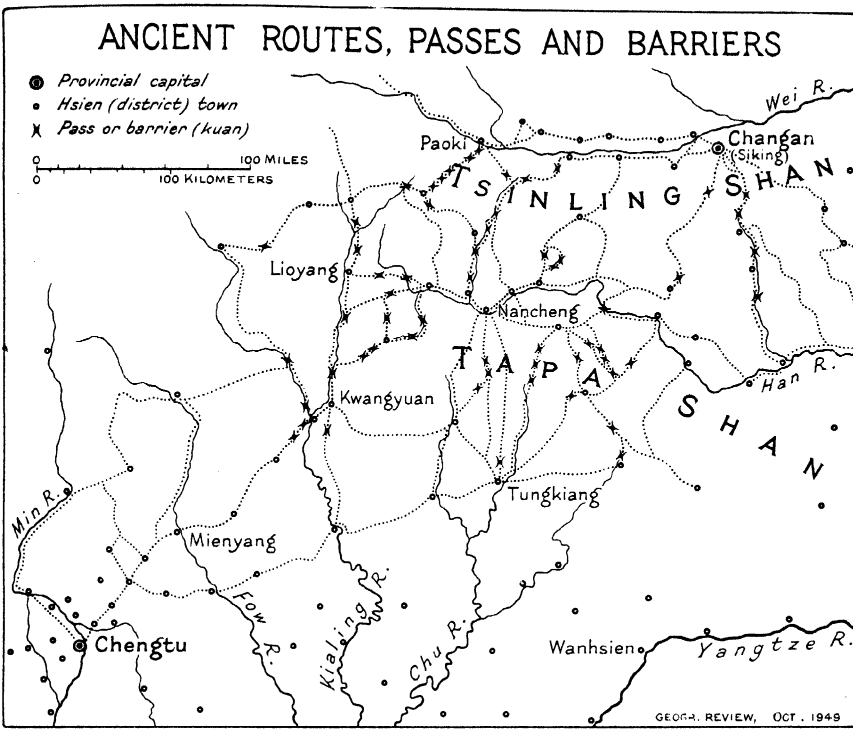

FIG. 2—For a map of the modern highways see Figure 12, p. 597.

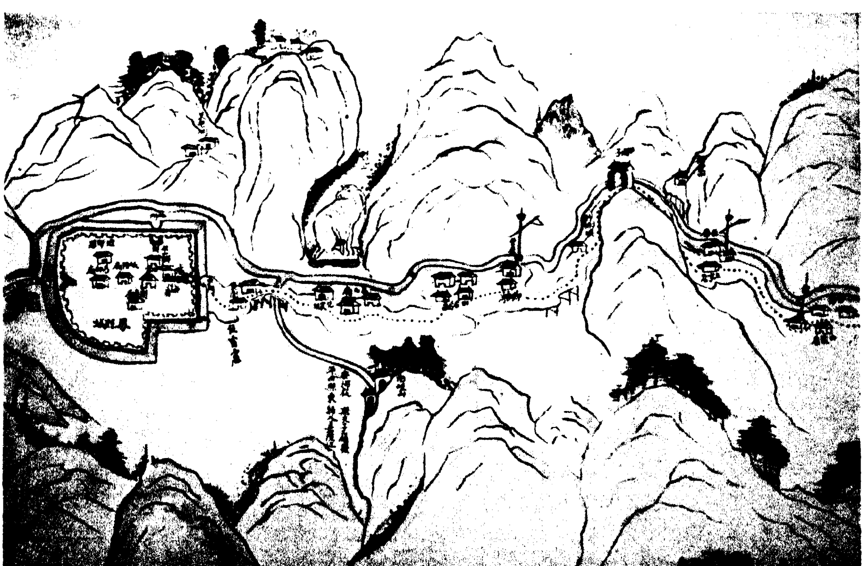

FIG. 3—Photographic copy on a reduced scale of a section of a 60-foot-long scroll map of the Linking Cloud trestle road dated sometime during the Ch'ing dynasty. The walled enclosure depicts the town of Fenghsien. The original is in the Library of Congress.

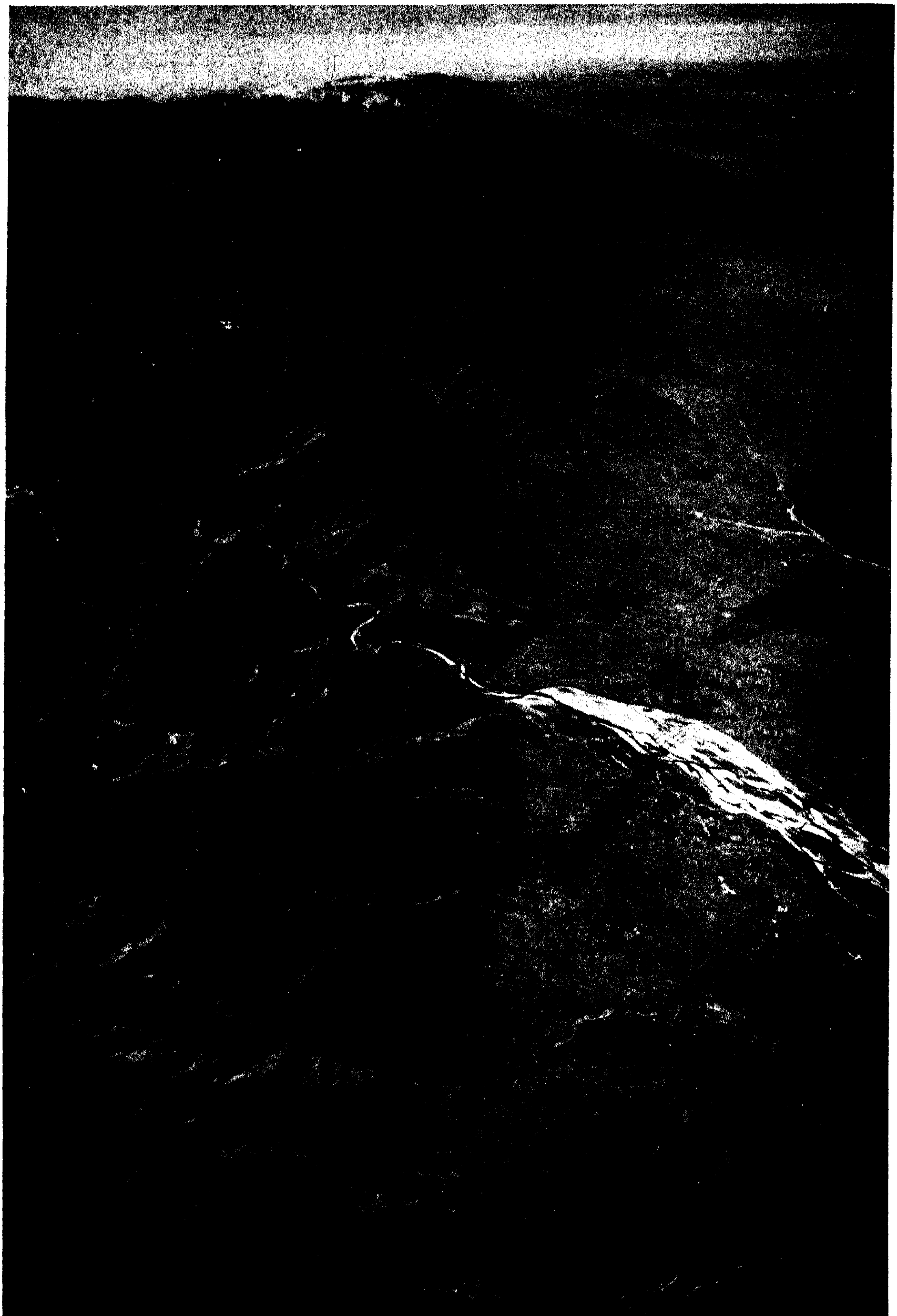

FIG. 4—The abrupt rise of the Tsinling Mountains from the Wei River plain is seen in this aerial view looking westward up the Wei River Valley from above Chowchih, Shensi.

Fig. 5—A view in the western section of the Tapa Shan and the rugged Tibetan border country of northwest Szechwan, illustrating the obstacle presented here to north-south communications in West China.

gravitation westward. Had Chungking been the leading center, the main route no doubt would have followed the valley of the Chienyu River due south to Shihchuan on the Han River and thence crossed the Tapa Shan to Wanyuan, from which a navigable tributary leads to the Chü River, the Kialing, and Chungking.

A final factor fixing the main transmontane route along the Lien-yün Tao was the relatively easy access it provided to the Kialing River, the source of which is only about 50 miles from the Wei River. This stream is navigable for native boats as far as the Kansu border and provides an alternative and quick route southward through the Tsinling Shan and the Tapa Shan, cutting the Road of the Golden Oxen at Chaohwa City.

The importance of these western transmontane roads is indicated by the immense engineering effort put into them. During the Later Han period (A.D. 25–220), merely to repair and rebuild the 430-mile official road through the mountain belt required three years and 23 million man-days of the conscripted labor of 766,800 men.[9] About a third of this road rested entirely on wooden trestle shelves propped upon canyon cliffs or along stream beds. Liu Ting-sheng asserts that the Ch'in and Han unification of China was accomplished through the use of Szechwan resources via the channel of the Tsinling Shan trestle roads. Pai Shou-i lists the transmontane road to Chengtu as one of the six main trunk roads of the great T'ang-dynasty network (A.D. 618–907).[10] Tao Hsi-sheng, a Chinese political scientist, goes even further in stating that, broadly speaking, there were only four main courier routes during the T'ang period, of which the Tsinling Shan road to Chengtu was one.[11] During the military events of the Three Kingdoms period and in subsequent times of political division in China the roads through the Tsinling Shan were of prime political and military importance.[12]

It is not only in their administrative and military aspects, however, that these routes have been of vital importance. They were channels by which cultural influences traveled southward from the Wei Ho Valley. Thus a highly developed system of irrigation was introduced into the Chengtu Plain. The city of Chengtu itself was planned and built two centuries before

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[9] Pao-ch'eng Hsien Chih (Pao-ch'eng District Gazetteer), 1831, ch'uan 8, p. 2.

[10] Pai Shou-i: Chung-kuo Chiao-t'ung Shih (History of China's Communications), Shanghai, 1937, p. 115.

[11] Tao Hsi-sheng and Wu Hsien-hsiang: Nan-pei-ch'ao Ching-chi Shih (The Economic History of the Period of North and South Dynasties), Shanghai, 1937, pp. 101–102.

[12] See Mei Hsien Chih (Mei District Gazetteer), 1909, ch'uan 1, pp. 11–13, also Liu-pa T'ing Chih (*op. cit.*), also Chi, *op. cit.*, p. 102.

Christ in imitation of the Ch'in capital at Sienyang in the Wei Ho Valley.[13] By these spillways famine refugees from the impoverished loesslands poured into rich Szechwan many times in ages past; over these routes transplanted populations moved both northward and southward. Such influxes often brought trained artisans and craftsmen into the Red Basin to diversify the culture of Szechwan. Kao-tsu found here his path of conquest to become the founder of the long-lasting Han dynasty. Twice, too, these transmontane routes of the west became the paths of flight of emperors seeking the sanctuary of protected Szechwan.[14]

The routes were also channels of trade. Although private interregional trade has been discouraged by various Chinese rulers, even in periods of strictest control it has persisted along the Tsinling Shan routes. The publicized fame of the Great Silk Road to Inner Asia and Rome has obscured the fact that the silk itself originated in Szechwan and was carried northward over the Chan-tao or trestle roads of the Central Mountain Belt.[15] The Chan-tao might therefore be considered the first segment of the Silk Road. It is of some interest, furthermore, that one of the principal forms of native transport in North China, the wheelbarrow, was developed and first used on the Tsinling Shan roads by the hero of the Romance of the Three Kingdoms, Chu-Ko Liang.[16]

Decline of North-South Communications in the West

With the southward expansion and consolidation of the Chinese nation and the development of the productive ricelands in the lower Yangtze delta and the building of the Grand Canal, the "key economic area" shifted from the Yellow River plain to the Yangtze Valley. As the Yangtze became increasingly dominant as a transport route, transmontane north-south trade in the west declined in favor of an east-west alignment. In the reign of the Han emperor Wu-ti (140–86 B.C.) the need for grain in the imperial capital in the Wei Ho Valley had led to an unsuccessful attempt to establish canal transport across a large part of the western Tsinling Shan along the Pao River.[17] After the construction of the Grand Canal, tribute grain could be

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13 Liu, *op. cit.*

14 Han-chung Hsi-hsiu Fu-chih (Revised Gazetteer of Han-chung Prefecture), 1815, ch'uan 1, Chan-tao maps.

15 [Albert] Terrien de Lacouperie: Western Origin of the Early Chinese Civilisation, London, 1894, pp. 196–198.

16 Tz'u Hai [encyclopedic dictionary], Shanghai, 1937, Sect. Ch'en, p. 84. In the opinion of L. Carrington Goodrich (A Short History of the Chinese People, New York and London, 1943, p. 78) the invention of the wheelbarrow is "rather dubiously" assigned to Chu-Ko Liang.

17 Shih Nien-hai: Chung-kuo ti yün-ho (China's Canals), Chungking, 1944, p. 43.

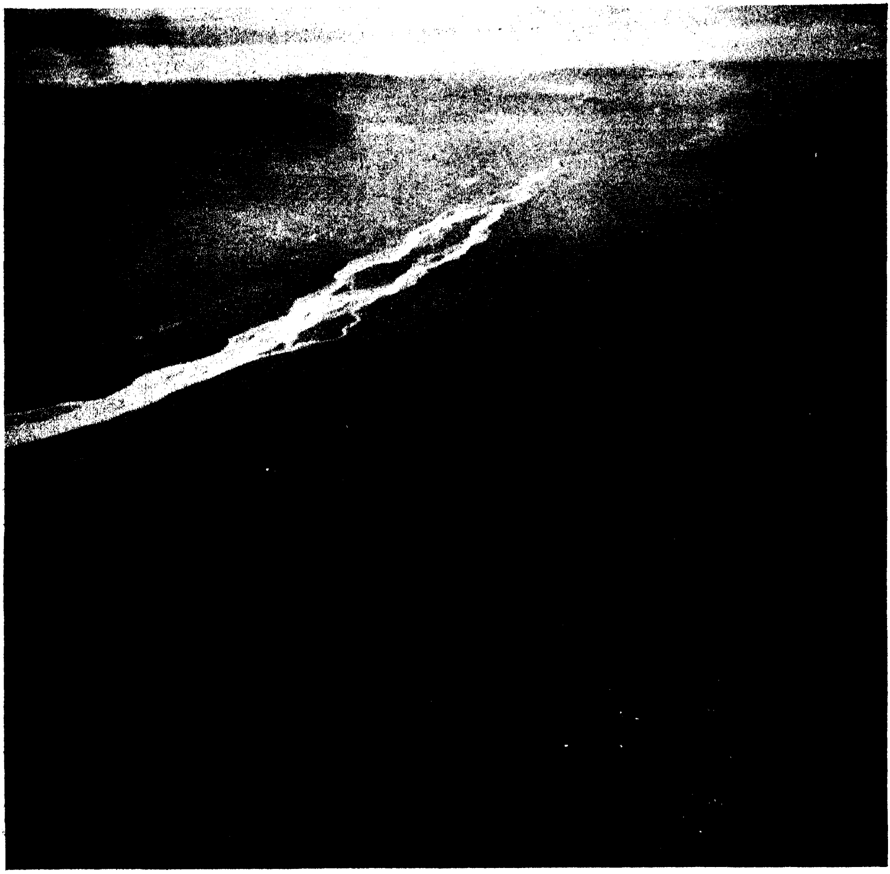

FIG. 6—The Wei River and plain with the Tsinling Shan in the distance. Hardly a square foot of the plain is unoccupied. The motor highway at the lower right (cf. Fig. 12); nearer the river the Lung-hai Railroad.

FIG. 7—Deep gashes made by erosion in the flat plain of the Wei River. The beginning of badlands formation here illustrated marks the beginning of increasingly difficult communications in the semiarid loess land.

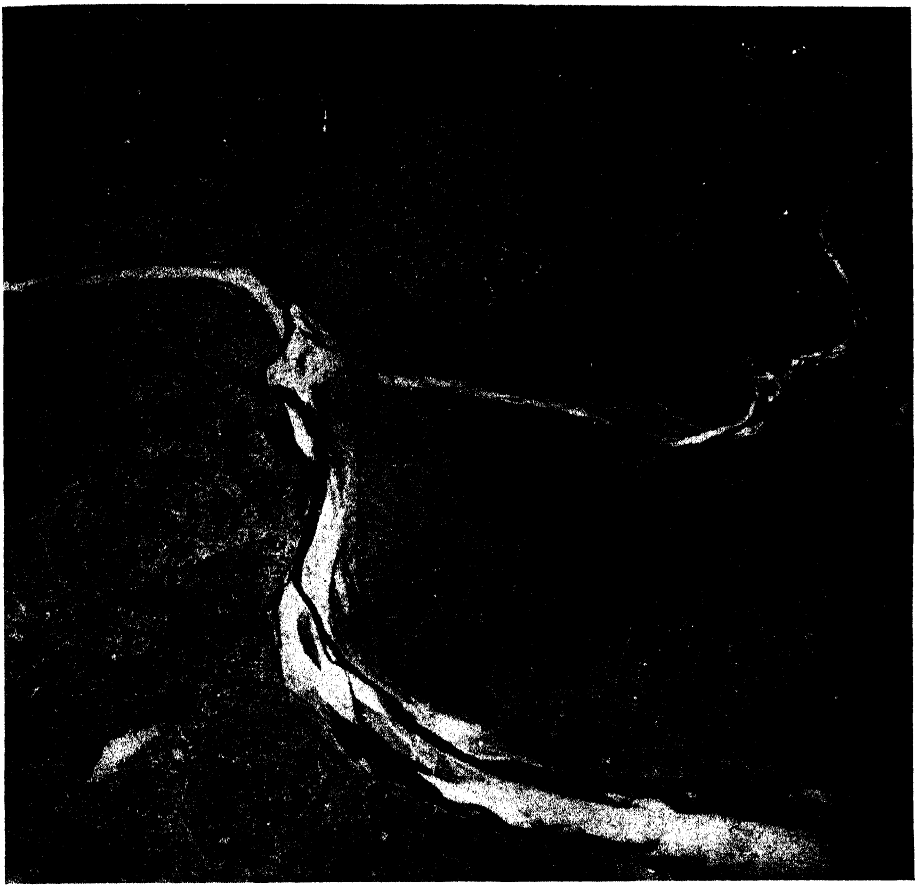

Fig. 8—The Hanchung Valley from a point above Hanchung (Nancheng) looking southeastward toward the Tapa Shan about Chingshihkwan. A highway enters the Tapa Shan at the right.

Fig. 9—Aerial view of Yungchow city and one of the deep loess canyons which form such serious obstacles to communications in the western part of the Wei River Valley. The city wall is 20 to 25 feet high.

transported more cheaply down the Yangtze and northward along the Grand Canal than by pack animal across the mountains. The later shift of the seat of administration from the location south of the Yellow River to Peking in the northeast also emphasized this factor.

At the end of the Ming period (after 1644) civil disorders resulted in the annihilation of a large part of the population of Szechwan. The province also suffered depopulation and chaos during the T'ai-p'ing Rebellion, which lasted from 1850 to 1866. Thanks to the Tsinling Shan barrier, the Wei Ho Basin of Shensi escaped the T'ai-p'ing rebels, but it was ravaged by the Muslim Rebellion, lasting from 1862 to 1877.[18] Such disorders and loss of population greatly reduced the north-south trade and led to neglect of the mountain roads.

More recently, railroad development under the drive of foreign interests in China was directed toward tapping the raw-material resources of the interior and creating a westward channel for foreign products entering from the Pacific coast. The Lunghai Railroad offered a means of cheap transport eastward of bulky products from the Wei Ho Valley and Kansu, and the Han River and the Yangtze River served the same purpose for south Shensi and Szechwan respectively. The reluctance of commerce to exchange products across the difficult Tsinling Shan barrier was thus increased.

The multiplicity of routes through the mountain belt that are now known and used[19] contrasts with the comparative paucity during the earlier historical period, due not so much to the elevation of the passes and the ruggedness of the terrain as to the lack of human settlement along possible routes. The deforestation of much of the mountain area, particularly in the accessible valleys, has largely removed the obstacles. The savage animals that once made travel dangerous are gone for the most part. Settlements of isolated farmhouses and small agricultural villages have penetrated into much of the Tsinling Shan and the Tapa Shan, so that the present-day traveler can usually find a bite to eat and a modicum of shelter at reasonable intervals. In 1892:

> The ancient trestles are no longer essential and are becoming dispensed with. One may travel by various and numerous routes now. Hoping to evade excise taxes that are collected along the better road of the courier route, commercial travelers and traders go from Pao-chi into Szechwan via Hui and Liang-tang, and go from Yang direct to Mei and Ch'i-shan, most of them using small paths.[20]

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[18] A. W. Hummel, edit.: Eminent Chinese of the Ch'ing Period, 2 vols., Washington, D. C., 1944–1945, Vol. 1, pp. 362–368, and Vol. 2, p. 765.

[19] Lin Chao: The Tsinling and Tapashan as a Barrier to Communications between Szechwan and the Northwestern Provinces, *Journ. Geogr. Soc. of China*, Vol. 14, 1947, pp. 5–14.

[20] Feng Hsien Chih (*op. cit.*), ch'uan 1, pp. 15–20.

It was only natural that the diminished dependence on the official road should result in less interest in its upkeep.

New Importance of Western Communications

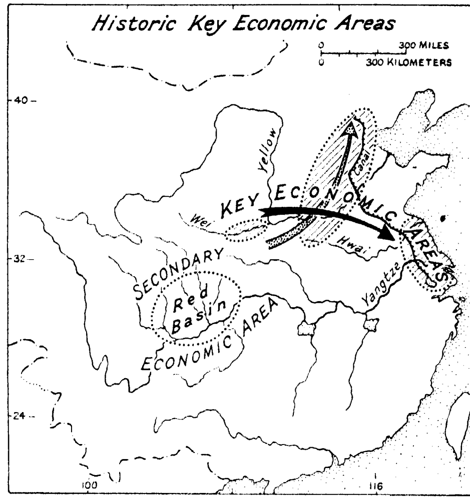

FIG. 10—Szechwan's trade routes were realigned after completion of the Grand Canal, c. A.D. 600.

The resurgence of the old channels of communication between the Wei Ho Valley and the Szechwan Basin is to be attributed, on the one hand, to certain entirely new circumstances and, on the other, to some of the old factors operating under increased compulsion.

In the first place, although the "key economic area" continues to be the lower Yangtze Valley, China's preoccupation with seaboard development to the exclusion of the western interior has been modified first by the Japanese invasion from the east and second by the Russian threat in the northwest. The Japanese invasion forced Nationalist China to rely for a long period largely on the resources of Szechwan and adjacent western provinces. At the same time, it compelled China to re-evaluate its western resources, particularly with a view to future reconstruction, industrialization, and political strengthening of the country. The conclusions of such an assessment, though at times soaring on the wings of wishful thinking, awakened an immense interest in the possibilities of the undeveloped west, particularly Sinkiang Province.[21] In the last decade numerous travelogues, newspaper articles, and more scholarly studies have been published concerning the "frontier regions."

The necessities of war communication and transport pushed the construction of the first motor highway over the Tsinling Shan to make possible the support of the Chinese Nationalist armies of the north.[22] This highway, one of the principal wartime engineering works and a rival of the Burma Road, for a time also brought military supplies to beleaguered Chung-

[21] On the Academia Sinica Expedition of 1943 to examine possibilities for development see Chang Chih-yi: Land Utilization and Settlement Possibilities in Sinkiang, *Geogr. Rev.*, Vol. 39, 1949, pp. 57–75.

[22] *Ssu-ch'uan Ching-chi Chi-K'ang* (*Szechwan Economic Quarterly*), Chungking, April, 1945, pp. 58–62.

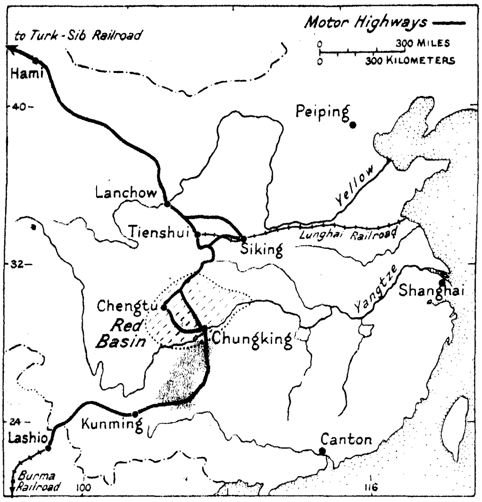

FIG. 11—A map of China's chief westward highway connections.

king by way of the Turk-Sib Railway and the Sinkiang-Kansu Highway, then the only alternative supply route to the Burma Road.[23]

The Russian threat in western Sinkiang is both economic and political. To a Nationalist China, the necessity of strengthening contact with the unstable northwest is obvious. Easier land access to the abundant food and manpower resources of traditionally conservative Szechwan would be one answer. Should the Chinese Communists overrun China, the political importance of good communications between Szechwan and Inner Asia northwestward across the Tsinling Shan would be increased by the greater intimacy of China with Soviet Russia. The rise of Szechwan as a political base in dealing with the northwest indicates the extent to which the ancient traditional roles of Shensi and Szechwan have changed, and how the political and cultural functions of the Tsinling Shan and Tapa Shan routes have been reversed.

In economic exchange, too, between southwest and northwest a new situation is developing, in which the technology of modern transportation makes profitable hitherto uneconomic transactions. At least a part of the products that have been forced to use the east-west channel of the Lunghai Railroad and the Yangtze River will be diverted in the future to the north-south transmontane trade routes. Potentialities have always existed for the interchange of the products of the humid semitropical Szechwan Basin and those of the dry continental loessland and steppe, but they have been held in abeyance by transportation costs. The formidable mountains and deep canyons of the Tsinling Shan and the Tapa Shan that have impressed Western travelers from Marco Polo to Baron von Richthofen raise the question of the economic feasibility of railroad construction. Motor transport can surmount the great barrier ranges. The present motor highway has a maximum grade in

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[23] See Owen Lattimore: China's Turkistan-Siberian Supply Road, *Pacific Affairs*, Vol. 13, 1940, pp. 393–412.

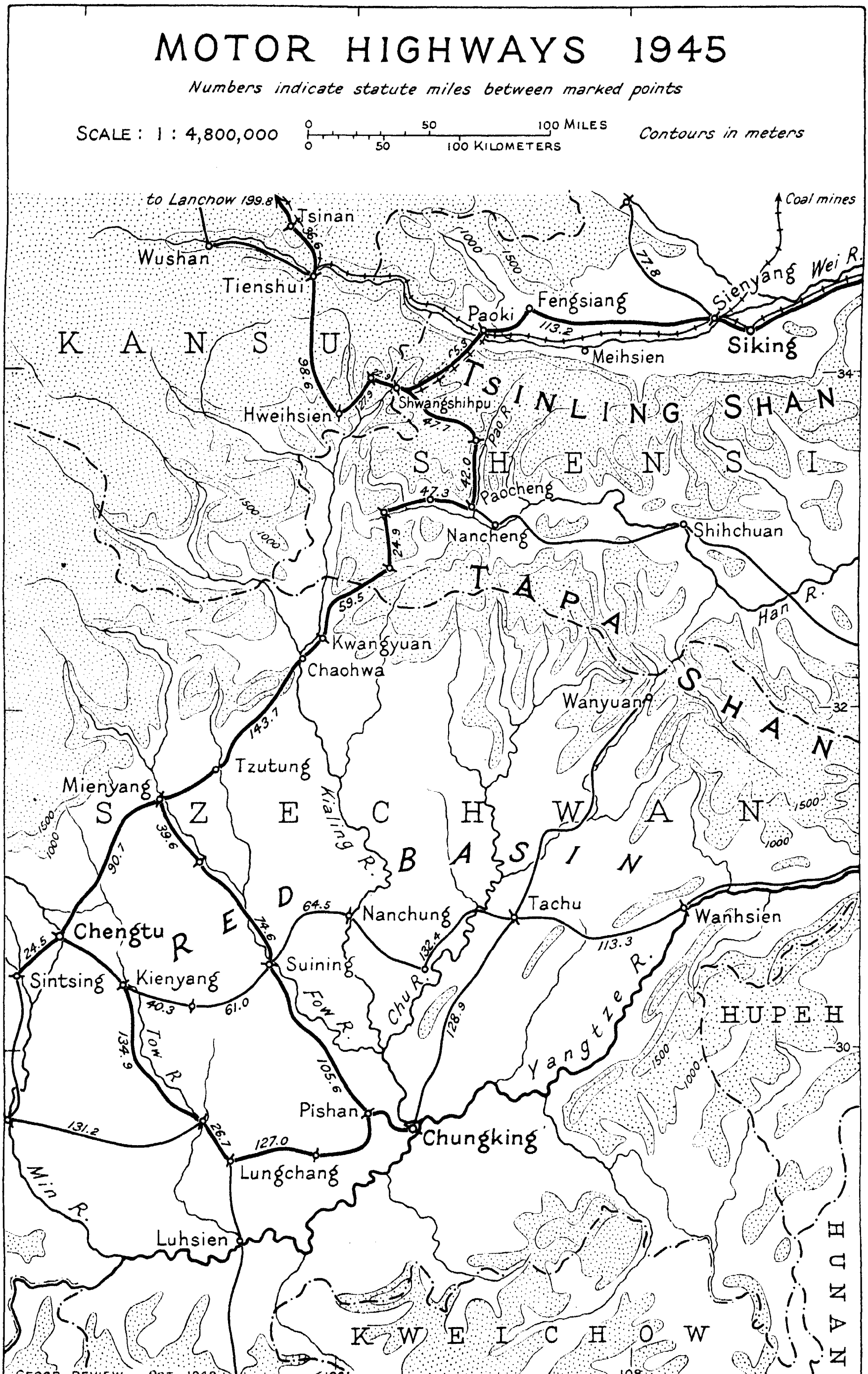
MOTOR HIGHWAYS 1945
Numbers indicate statute miles between marked points
SCALE : 1 : 4,800,000
0 50 100 MILES
0 50 100 KILOMETERS
Contours in meters
to Lanchow 199.8
Tsinan
Wushan
Tienshui
Coal mines
Wei R.
Sienyang
Fengsiang
Paoki
Meihsien
Siking
KANSU
TSINLING SHAN
SHENSI
Hweihsien
Shwangshihpu
Pao R.
Paocheng
Nancheng
Shihchuan
Han R.
TAPA SHAN
Kwangyuan
Chaohwa
Wanyuan
Tzutung
Mienyang
SZECHWAN
RED BASIN
Kialing R.
Nanchung
Tachu
Wanhsien
Chengtu
Sintsing
Kienyang
Suining
Fow R.
Chu R.
Yangtze R.
HUPEH
Tow R.
Pishan
Chungking
Lungchang
Min R.
Luhsien
KWEICHOW
HUNAN
GEOGR. REVIEW, OCT. 1949

FIG. 12

short stretches of 16 per cent.[24] In wartime the use of the road was limited largely to military and other government transport, so that the economics of commercial freight carriage cannot be evaluated because of the inflation and lack of statistics. Although fuels range from gasoline and charcoal to alcohol, rapeseed, and tung oil, all motor fuel is expensive in China, and gasoline, the most efficient, is also the most expensive, or at least its acquisition requires foreign exchange, whereas the other fuels are obtainable locally.[25] But the speed and relative convenience of motor transport have brought a continued lively demand for passenger space, even in cargo trucks, and it seems probable that motor transport would do a profitable business even with high fuel costs.

Railroad Prospects

Nevertheless, it is rail transport that would bring about revolutionary changes in the transmontane trade and provide a political and cultural binder in the internal unification of China. Such rail connections were envisaged in Sun Yat-sen's plan for a railroad net for China.[26] The operation of a railroad through the Central Mountain Belt requires power for its locomotives even where its value is only political. The only practical fuels for locomotives at present are coal and hydroelectricity, both of which could be made available for transmontane railroads between the Red Basin and the Wei Ho Basin. The same mines about 30 miles north of Sienyang, Shensi, that are the source of coal for the Lunghai Railroad could be used for the Tsinling Shan section of the transmontane line. Szechwan coal from the Kwangyuan and Chengtu areas could supply the southern section.[27]

There are numerous possible hydroelectric-dam sites in the Central Mountain Belt. The rainfall south of the Tsinling Shan divide is sufficient in amount and satisfactory enough in distribution to provide water for hydroelectric development. The cover of vegetation on the southern slopes of the mountains prevents the excessive silting found in the rivers north of the divide. A Chinese engineer has shown in a study of one development site that a dam 200 feet high and 1056 yards long across the Pao River just north of Paocheng could supply power for the operation of a 35,000-kilowatt

[24] From a report of a survey by the United States Army Engineers, March, 1945.

[25] There are several oil seepages in the red beds of Szechwan, but prospects for production are not encouraging; exploration in the older rocks, however, is believed to be worth consideration (J. M. Weller: Petroleum Possibilities of Red Basin of Szechuan Province, China, *Bull. Amer. Assn. of Petroleum Geologists*, Vol. 28, 1944, pp. 1430–1439).

[26] H. J. von Lochow: China's National Railways, Peiping, 1948, p. 15.

[27] Chow Li-san and others: Economical Atlas of Szechuan, China Institute of Geography, Peipei, Szechwan, 1946, p. 54.

plant for most of the year. This is estimated as enough power to run a meter-gauge railroad across the Tsinling Shan and part of the Tapa Shan and to meet all the light and power requirements of the upper Han Basin cities and towns as well.[28] The question of power for locomotives does not, therefore, present insurmountable problems. In view of the likelihood that hydro-electric projects of any considerable magnitude will be slow in forthcoming, coal will no doubt be the fuel used for powering locomotives in this region.

What are the prospects for, and what steps have been taken to bring about, the realization of this transmontane rail connection? In China's First Five-Year Plan, drawn up in 1936, a line was projected following the thousand-year-old courier route now also followed by the motor highway. A Belgian loan of 450 million francs was secured with a first charge on the revenues of the line, an indication that it would be profitable.[29]

The First Five-Year Plan was drawn up before the economic and political significance of China's Far West had been realized, and the war also prevented its execution. In a Second Five-Year Plan, projected in 1947, the northern half of the trans-Tsinling Shan railroad from Chengtu has been diverted; instead of running from Kwangyuan to Paocheng and then north, it now is to run up the Kialing River from Kwangyuan and then cross the Tsinling Shan divide to Tienshui on the upper Wei Ho. Engineering surveys have been completed for both routes. From Tienshui a railroad to Lanchow on the ancient Silk Road to Inner Asia was already under construction in August, 1947.[30]

At the same time, construction was pushed on a second trans-Tsinling Shan railroad, a meter-gauge spur line of the Lunghai Railroad running south along the old Linking-Cloud Road from Paoki. This line runs to Shwangshihpu in the middle of the Tsinling Shan and was reportedly completed by January, 1948.[31] When the line from Chengtu to Tienshui is constructed, the 50-mile gap between Shwangshihpu and Hweihsien on the spur line will undoubtedly be quickly spanned to bring Paoki into direct railroad connection with Chengtu.

Thus the ancient courier route dating from the Sung dynasty finally has a new face. On the gravel-surfaced motor road mechanical monsters made on the opposite side of the earth now chug along where hardy ponies once pounded the shelflike trestles of the Chan-tao. Instead of the grass and gruel

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[28] *Shui-li Wei-yuan-hui Yueh-kang* (*Water Conservation Commission Monthly Journal*), Vol. 1, No. 7 China, Executive Yuan, July, 1944, pp. 16–17.

[29] Von Lochow, *op. cit.*, p. 118.

[30] *Ibid.*, pp. 76–77.

[31] *Ibid.*, p. 55.

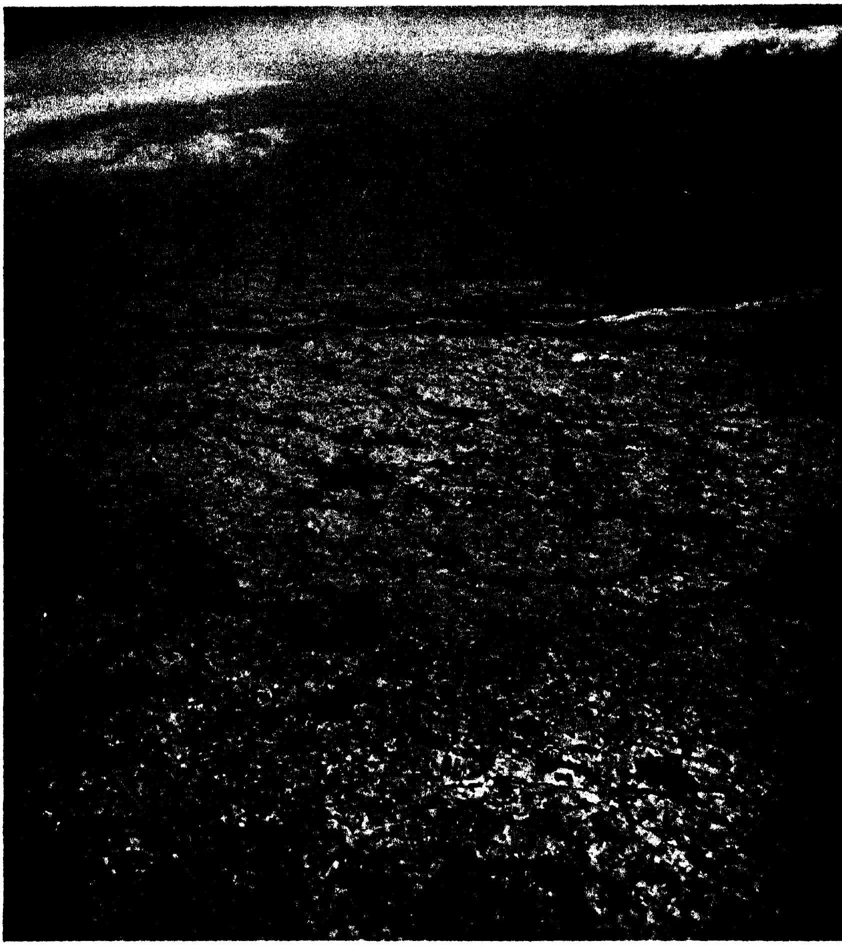

FIG. 13—Aerial view of the Chengtu plain near where the motor highway (white line in lower left) from Shensi enters it. The agricultural pattern of the moist Szechwan Basin is in distinct contrast with the pattern of the Wei River plain (Fig. 6). In the far right are the peaks of the rarely seen Great Snowy Mountains.

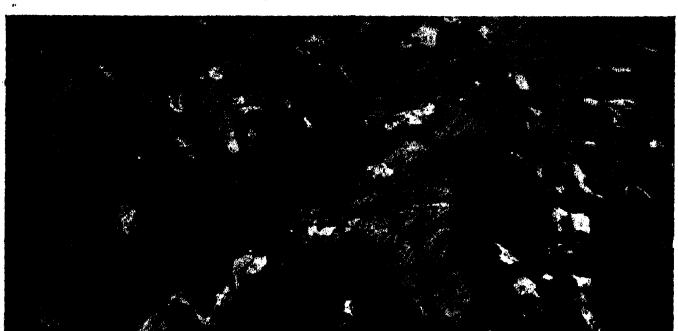

FIG. 14—Small scattered patch farming in the central section of the Tsinling Shan near the town of Fuping. Such penetration by mountaineer farmers has made possible the use of numerous though difficult routes crossing the mountain belt.

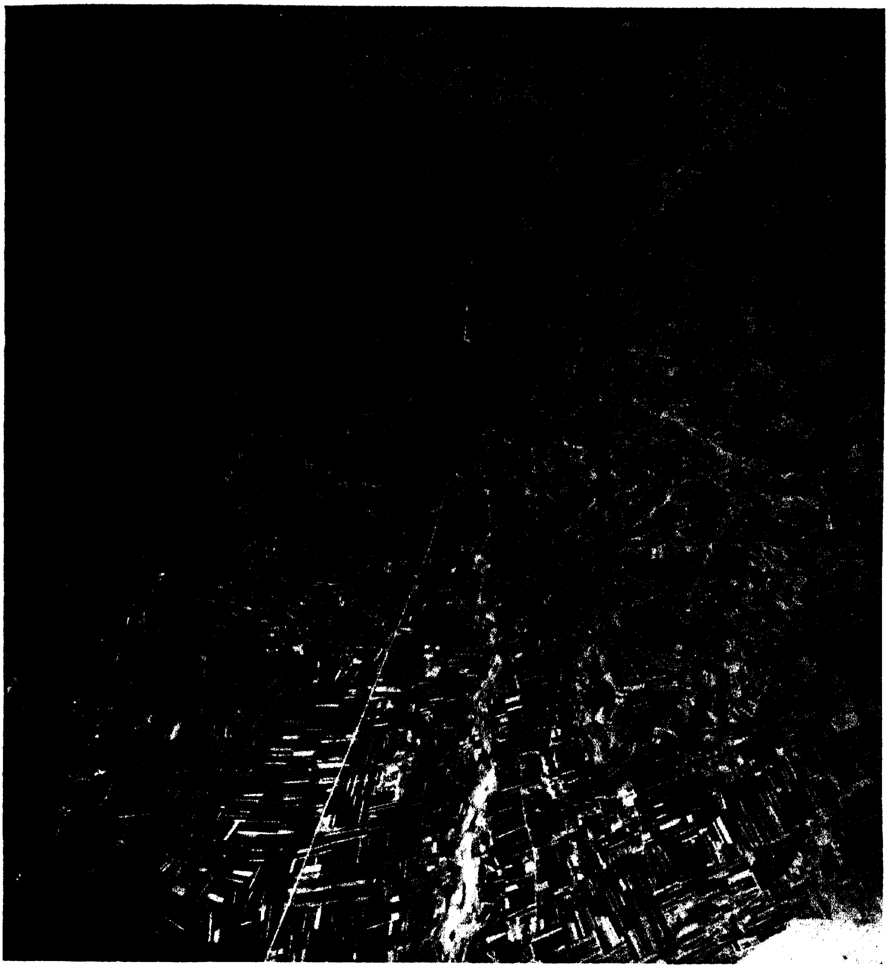

FIG. 15—Aerial view from above Paoki looking toward the Tasankwan (Ta-san Barrier). The motor highway crossing the Tsinling Shan is seen here entering the mountains after following the right bank of the Chien-yu Ho, a small stream tributary to the Wei River.

FIG. 16—The walled town of Mienyang, Szechwan, on the Shensi-Szechwan highway. Both the flat-topped hills and the valley bottoms and slopes are cultivated, the former with dry crops, the latter with paddy rice.

fed the courier ponies, a strange and varied assortment of fuels feed the new conveyances. Trailing clouds of smoke, the rather broken-down motor trucks and buses meet the symbols of the past at every point along the route. At Miaotaitze in the Tsinling Shan they come upon the beautiful temple dedicated to Chang Liang, adviser to the first Han emperor. Now it houses the modern China Travel Service Hostel. T'ang-dynasty Buddhist carvings at the Thousand Buddha Cliff a few miles north of Kwangyuan tell the traveler that this was the route along which Buddhism entered Szechwan to found one of its five most important monastery centers in China on 11,000-foot-high Mt. Omei, southwest of Chengtu. Seven miles north of Tzetung a temple dedicated to Kuan-yin and Wen-ch'ang testifies to the influence of North China architecture in the Szechwan Basin. At Tzetung itself two stone tablets, one dating from the Han dynasty and the other from the T'ang dynasty, remind us that Han civilization and culture came into Szechwan from the north. And in the village of Shihniupao south of Tzetung a half-life-sized stone ox calls to mind the mythical origin of the Road of the Golden Oxen.[32]

Szechwan traditionally has been a province of great inertia. It was the last to succumb to revolutionary upheaval. If civil disorder breaks out there, it tends to continue long after other provinces have been pacified.[33] In part, this may be attributed to the isolation, in part to the large population and area. Better communications may reduce the inertia and at the same time increase Szechwan's influence upon its neighbors.[34]

"The southwest and the northwest represent China's future," writes a Chinese author.[35] That the importance of transmontane communications linking these two regions was recognized before the Japanese invasion forced the Chinese government to seek refuge in the west is shown in a statement by T'ang Liang-li in 1935: "The Sian-Hanchung highway is not only important from a commercial standpoint, but is also strategic from the viewpoint of national defense."[36]

Strategically, as a military channel from a secure supply base, the road is important for the control of the northwest. The reliable productivity of

[32] From notes taken by Schuyler Commann on his trip over the route in 1945.

[33] S. C. Yang: The Revolution in Szechwan, 1911–1912, *Journ. West China Border Research Soc.*, Vol. 6, 1933–1934, pp. 64–90.

[34] The contrasts described above hold good in other matters. See, for example, Dr. Joseph Needham's report on "Science in Western Szechuan," *Nature*, Vol. 152, 1943, pp. 343–345 and 372–374. See also H. L. Richardson: Szechwan during the War, *Geogr. Journ.*, Vol. 106, 1945, pp. 1–25.

[35] C. Y. W. Meng: China Should Have a Great Northwestern Railway, *China Weekly Rev.*, Jan. 20, 1940, p. 276.

[36] T'ang Liang-li, edit.: Reconstruction in China, Shanghai, 1935, p. 233.

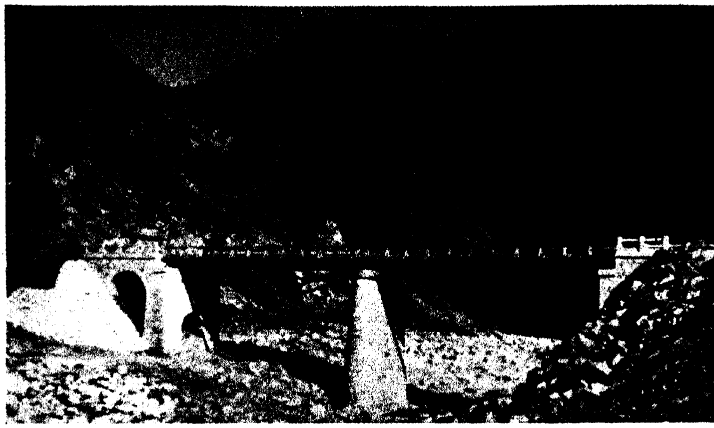

FIG. 17—A modern highway bridge on the Tsinling sector of the Shensi-Szechwan highway, north of Paocheng, Shensi, 1945. (Courtesy of S. Franklin.)

FIG. 18—The motor highway in the central part of the Tsinling Mountains passing the ghost town of Liupa, 1945.

FIG. 19—Temporary bridge for winter low-water use by motor traffic on the highway near Paoki, Shensi, 1945. (Courtesy of S. Franklin.)

Szechwan and its immense manpower of more than 50 million people are invaluable assets making it such a base.

In China's northwest the political and cultural ties that bind the different peoples under Chinese sovereignty are loose. Chinese control at times is ineffective, if for no other reason than that manpower and materials for the support of the state administration are not readily available. Railroad connection between the Red Basin and the northwest will open up the large manpower and rich resources of Szechwan for quick support in the carrying out of China's administrative policies in the northwest. A stabilizing effect on the political situation would seem to be a logical consequence, regardless of whether the Chinese administration is Nationalist or Communist or a coalition government.

Economically, too, the transmontane routes will be more significant. North and south of the Central Mountain Belt are different climatic regions, producing different, specialized commodities. Szechwan needs the petroleum, hides, wool, and cotton of the dry northwest; the northwest needs the sugar, tea, rice, and other semitropical products of Szechwan.[37] Both northwest and southwest can furnish important contributions to China's future industrialization.[38] By making possible the quick movement of food northward from Szechwan, improved land communications will lessen the insecurity of livelihood in the northwest that derives from the unreliable rainfall. Greater economic security will in turn reduce the danger of political uprisings.

The only other feasible channel of transport for bulk cargo between southwest and northwest is an extremely roundabout route along the Yangtze River, northeastward around the Tsinling Shan barrier, and then westward through the narrow Yellow River passageway. The western Tsinling Shan land routes are therefore destined to play a role perhaps even more important than in the ancient past. The paths to the riches of Szechwan were once the wooden trestle roads. Today they are the motor highway and the railroad. The cultural orientation of the Tsinling Shan routes has been shifted, however. In the past they served to expedite the political and economic penetration of Szechwan. In the present they reach northwestward from Szechwan to strengthen the economic structure and political unity of greater China.

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[37] See, for example, C. Y. Hu: The Agricultural and Forestry Land-Use of Szechuan Basin. Chicago, 1946. (Noted in the *Geogr. Rev.*, Vol. 37, 1947, pp. 152–153.)

[38] H. D. Fong: The Post-war Industrialization of China, *Planning Pamphlets Nos. 12 and 13*, National Planning Association, Washington, D. C., 1942, pp. 28–29.

FRONTIERS BETWEEN EAST AND WEST IN EUROPE

WERNER J. CAHNMAN

ALTHOUGH many of us had learned to think in terms of "one world" by the end of the war, it would now seem that we are instead in need of "education for a divided world." This unpleasant truth obtrudes itself with particular force in view of the East-West conflict in Europe. Western civilization, now represented by the English-speaking nations and France, and the forces of the East, now represented by the Soviet Union, confront each other across the Elbe River and in Berlin. Who or what is to be blamed? Western imperialism? Soviet aggressiveness? The agreements reached at Tehran and Yalta? The lack of agreement ever since? These questions cannot be answered here. It must merely be pointed out that East-West frontiers in Europe are not new. Europe was born, as it were, with the scars of division across her face. More than once these scars have seemed to heal, only to reappear, so that in retrospect a pattern emerges which, if understood, could be a guide for future action. The nature of this pattern will be illustrated in a series of historical maps.

Frontiers in Central Europe

There have been many frontiers between East and West in Europe, but almost all of them have run through the area of German settlement in Central Europe. This has made German soil a battleground and German history strongly ambivalent.

THE ROMAN FRONTIER

When the curtain of history rises, the stage is already set. The initial and most enduring event in German history is the fact that ancient Roman penetration came to a standstill at a line marked by a stone wall called *Limes Romanus*. This wall reached from the middle Rhine north of Mainz to the upper Danube west of Regensburg (Fig. 1). The Roman legions failed to establish themselves for any length of time east and north of the Rhine and Danube Valleys. The battle in the Teutoburg Forest (*ca.* A.D. 9) did more than destroy the legions of Quintilius Varus; it cut Germany into a Romanized southern and western half and a barbarian northern and eastern half. The Romanized half comprises the Rhineland, Alsace, Switzerland, the greater part of South Germany, and Austria; the barbarian half comprised

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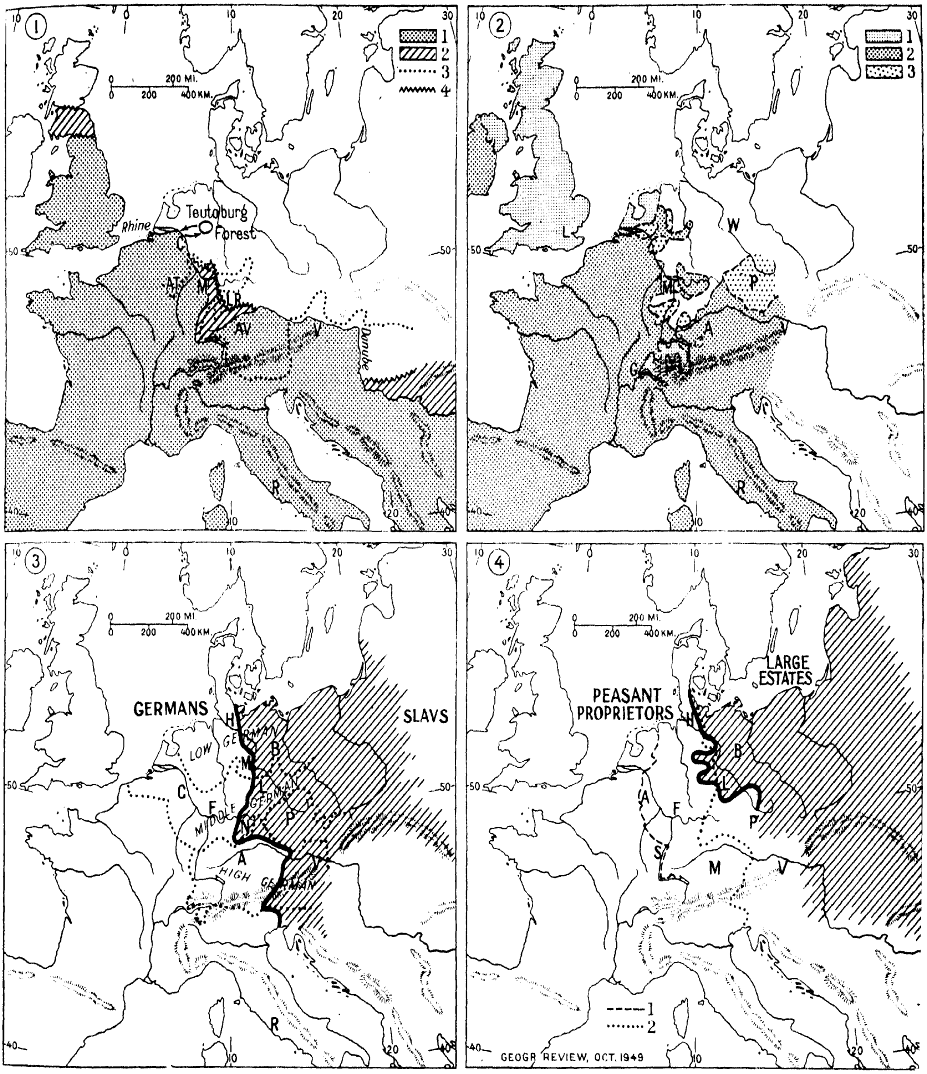
the remainder, especially the entire North German Plain from the Ruhr to the Vistula. And it may be noted that the northern and eastern limits of vine cultivation in the Rhine and Danube Valleys coincide almost exactly with the northern and eastern limits of Roman expansion. As a Mediterranean people, the Romans did not feel at home in the swamps and forests of the north.

This Roman frontier between West and East has vanished and reappeared time and again. The regions west and south of the *limes* became the seat of the Holy Roman Empire of the German Nation. This part of Germany, and this part alone, bore in those days a culture pattern comparable to that of Italy, Spain, France, and Britain. Furthermore, all the important centers of the medieval "Reich" lay west of the Roman wall up to the time of the Hohenstaufen (1138–1254), when the center of gravity shifted to the southeast and, later, to the northeast. West of the wall the territorial society of the late Roman Empire made its impact upon the emergent nations of Western Europe; ancient folk societies, tied with kinship bonds, were preserved in the East. In the West a *jus soli,* along with Latinized languages, became predominant, but in the East the *jus sanguinis* and native tongues continued to prevail. Moreover, in the sixteenth and seventeenth centuries the regions west and south of the wall remained largely Roman Catholic or adhered to the western, Calvinistic, branch of Protestantism, while the regions east and north of the wall became overwhelmingly Lutheran or were influenced by the Hussitic insurrection. The "barbarians" beyond the wall "protested" against Rome; Wittenberg, where Lutheranism was born, lies far to the east (Fig. 2).

THE SLAVIC FRONTIER

On the other hand, the westernmost line to which Slavic tribes from the East penetrated ran through Bavaria and Thuringia and roughly along the Saale and Elbe Rivers to the Baltic Sea near Lübeck. What is now German territory east of the Elbe-Saale line was occupied by Slavic tribes during the great barbarian migrations at the dawn of the Middle Ages. Later these regions were colonized by German settlers (Fig. 3). The territory to the west became the motherland, with an older culture and a more homogeneous social structure. The West, settled by various tribes separated by marked linguistic and other differences, subsequently split into numerous semi-independent political units—principalities, bishoprics, free cities, and the like. The East, as a colonial country, was thinly settled by Teutonic knights, priests, burghers, and farmers from all German tribes. High Germans, Middle Germans, and Low Germans participated in the eastward drive,



FIGS. 1–21—With the exception of Figure 20, the maps were originally prepared by the author for an Army Specialized Trair ing Program course at Vanderbilt University in 1944. Solid, broken, and dotted lines, except where otherwise indicated, show fror tiers and boundaries, both political and otherwise. Single-headed arrows show routes of political, military, cultural, commercial, et expansion. Politico-military "axes" are suggested by double-headed arrows. The weights of the lines and arrows show their relativ importance, and their meaning, where not obvious, is explained in the text. Important cities are indicated by their initial letters.

FIG. 1—The Roman frontier (first century A.D.). 1, the Roman empire; 2, border regions of the Roman Empire; 3, northern lim of vine culture; 4, fortifications; LR, Limes Romanus; AT, Augusta Treverorum (Trier); AV, Augusta Vindelicorum (Augsburg); (Colonia Agrippina (Cologne); M, Mogontiacum (Mainz); V, Vindobona (Vienna).

FIG. 2—The religious frontier (sixteenth century). 1, Western Protestantism; 2, Roman Catholicism; 3, mixed and contested area

FIG. 3—The Slavic frontier (ninth century).

FIG. 4—The frontier between the regions of peasant proprietors and of large estates (prior to 1945). 1, present western boundar of Germany; 2, the Slavic frontier (ninth century).

mixed with Slavic serfs in the process, and formed new populations. In order to maintain themselves against enemies without and within they had to obey strong rulers, and thus Prussia arose as a highly organized and militant state.

Other frontiers coincided with the early German-Slavic frontier and have persisted to this day. Aerial photographs reveal how sharp and distinct the division line still is. Today, centuries after the Slavic tongue died out east of the Elbe and the Saale, predominantly Slavic types of settlement are found there—long rows of houses along a single street (*Strassendörfer*) or houses built around a ring-shaped village green (*Runddörfer*), in contrast with the irregularly clustered villages (*Haufendörfer*) or dispersed farm dwellings characteristic of the older regions of purely Germanic or Germanic-Celtic settlements to the west. Furthermore, West and South Germany is a country of peasant proprietors, with large holdings in the northwest and in the parts of the southeast where dispersed dwellings prevail and with small holdings elsewhere; the East, until recently, was a country of large estates, and many of the villages were those of farm laborers rather than of proprietors. It is true that this line of division was blurred during the age of feudalism, when peasant proprietors and laborers formed one class of feudal serfs within the rural population. But after the freeing of the serfs in the early nineteenth century the old frontier reappeared and became of crucial importance in the rise of German nationalism (Fig. 4).

REAPPEARANCE OF FRONTIERS IN THE NAPOLEONIC ERA

A classic example of the simultaneous reappearance of the Roman-barbarian and German-Slavic frontiers of the early Middle Ages occurred in the years of crisis that followed the French Revolution. Napoleon's Europe (Fig. 5) was a Roman Europe with the Rhine as the eastern frontier. The Rhine as the frontier of a secular Roman Empire of the French nation had been a goal of French foreign policy ever since the days of Richelieu, but only when the long-crumbling Holy Roman Empire of the German Nation was finally dissolved (1806) was this goal attained. East of the Rhine the Confederation of the Rhine was founded (1806) as a buffer state between the West and the East, with an eastern boundary that roughly coincided with the old German-Slavic frontier. Yet, as the name of the Confederation indicates, its center of gravity lay in the Rhine region. The head of the Confederation had his residence in Frankfurt, the natural and historical center of the region. The valleys of the Rhine and the Po formed the basis for Napoleon's campaigns against Austria, Prussia, and Russia, the then major powers of the East.

The Europe of the Holy Alliance, constructed at the Congress of Vienna (1814–1815), was the complete reverse of Napoleon's Europe (Fig. 6). It was a Europe ruled by the three Eastern powers, Russia, Prussia, and Austria. Again, the frontier between East and West ran through Central Europe and split Germany in half, but this time it was the western frontier of the Austrian and Prussian domains that coincided roughly with the old German-Slavic frontier. Parts of Austria and Prussia were included in a German Confederation, whose smaller member states filled the area west of the German-Slavic line that had previously been occupied by the Confederation of the Rhine. Along the Rhine this German buffer area now faced the West instead of being allied to it. The Easternization of Germany, represented in literature by the romantic movement, was in full swing. We find its geographical expression in the Prussianization of the Rhineland.

The Rhine had become the western frontier of the East, and Earl Baldwin's assertion a decade ago that England was to be defended on the banks of the Rhine was only a belated restatement of an old truth. From its firm position east of the Rhine, the Holy Alliance sought to encompass the whole of Europe in an effort to quarantine the ideas of the French Revolution and counteract the disintegrating influence of Anglo-Saxon commercialism on the feudal societies of the East. When, however, the Holy Alliance tried to restore Spain as a major colonial power in the Western Hemisphere, it was effectively checked by British and American countermoves. The Monroe Doctrine, the result of close cooperation between England and the United States, was designed to keep the "continental" powers of Europe from gaining "oceanic" positions that would threaten Britain's dominion of the seas and the independence of the American republics. Viewed from that angle, the Monroe Doctrine might be regarded as a forerunner of the North Atlantic Pact, and the Holy Alliance as a bulwark of "Eurasia." But the Holy Alliance was, rather, a combination of conservative powers fearful of the aggressive tendencies of the West, whereas Hitler Germany and Soviet Russia have replaced feudalism with mechanization in an effort to beat the West on its own terms. Yet they have not changed the basic patterns of their culture. They are still engaged in a "war against the West."[1]

THE "OCEANIC-CONTINENTAL" FRONTIER

Another frontier between the West and the East has already been alluded to. Political geographers such as Friedrich Ratzel in Germany and Sir Halford

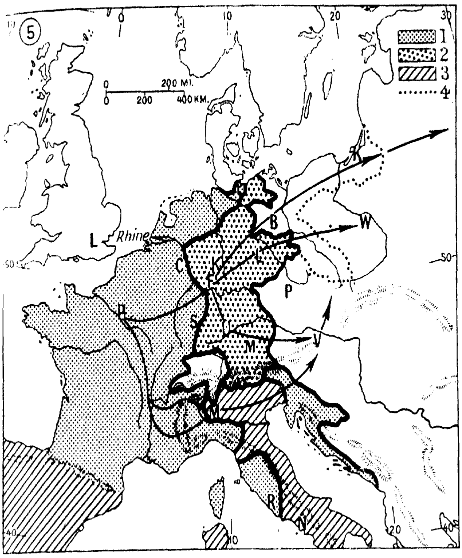
[1] Aurel Kolnay: The War against the West, New York, 1938.

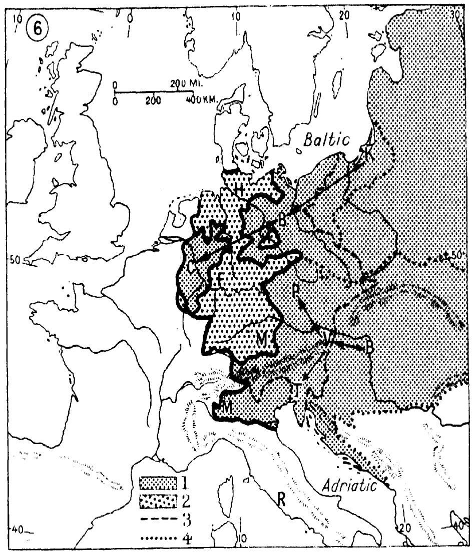
Mackinder in England have taught us to differentiate between "oceanic" and "continental" regions. "Oceanic" regions are those adjacent to the great sea lanes; "continental" regions, those whose rivers flow into ice-blocked Arctic waters or landlocked inland seas. The frontier between them again runs through Germany. The drainage basin of the Elbe, including Bohemia, belongs to the oceanic West rather than to the continental Northeast, and the valley of the Danube, including Bavaria, forms the connecting link between South Germany and the continental Southeast (Fig. 7). Prague combines a background of Slavic folk life with a Western economic and cultural outlook; Munich combines a Roman Catholic culture with a political orientation toward the Southeast. Berlin, which so often has been decried as not at all representative of Germany as a whole, lies exactly on the frontier, at a point where the "oceanic" and the "continental" regions of the North German Plain can be tied together by an efficient administration, in spite of differences in cultural heritage. Berlin is the center for a network of artificial waterways and the hub of a railroad system. It was the headquarters of a gigantic army of conquest, bent upon the task of uniting the oceans and the continents into a world empire, and is now once more the focal point of combat between contending systems.

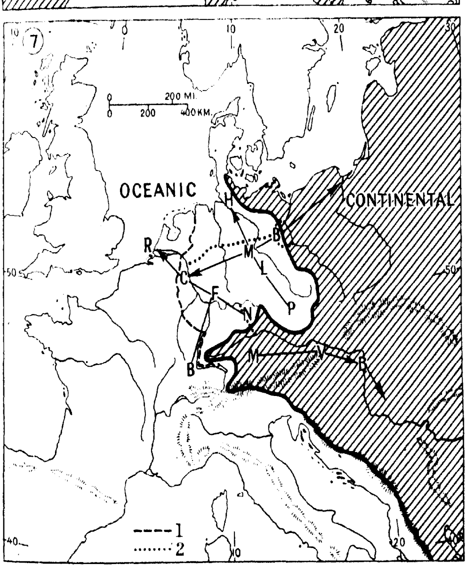
THE FRONTIER BETWEEN LATIN AND GREEK CHRISTIANITY

Only one major line of division between the West and the East lies beyond the German culture area, namely the frontier between Latin and Greek Christianity (Fig. 8). This coincides in general with the former western frontiers of the Soviet Union and the Balkan States and leaves merely a long, narrow strip of land extending from the North Cape to the lower Danube between the easternmost limit of the compact German settlement of pre-Hitler days and the westernmost limit of Greek Christianity. As a matter of fact, Greek Christianity appears historically as a part of the East rather than as a bulwark against it: it receded before Islam in the Near East; it submitted to the Turks in the Balkans; it was overwhelmed in Russia by the Mongols.

All the Asiatic conquerors except the Turks, who penetrated into the Balkan Peninsula by way of Asia Minor, reached Europe through the wide-open gateway of races and peoples formed by the steppes between the Urals and the Caspian Sea (Fig. 8). Hordes of Huns, Avars, Khazars, Bulgars, Magyars, Tatars, and Mongols pushed out from there toward the countries of the West. Hitler's attempt to conquer the East was aimed at Stalingrad, in the same region. Hitler knew what he was doing. The master of this







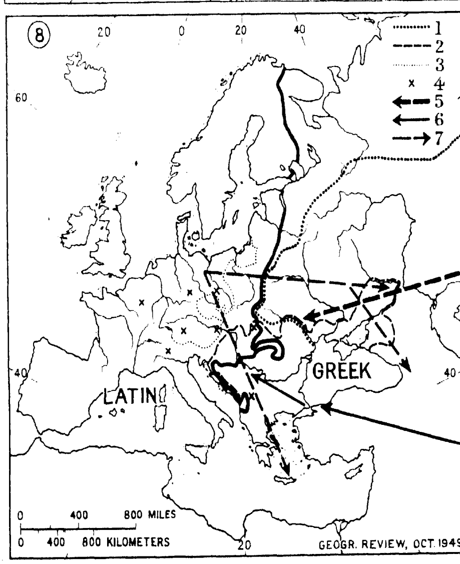


FIG. 5—The frontiers of Napoleonic Europe. 1, the French Empire; 2, its Spanish and Italian satellites; 3, the Confederation c the Rhine; 4, eastern boundary of Prussia, 1807.

FIG. 6—The Europe of the Holy Alliance. 1, Russia, Prussia, Austria; 2, small states belonging to the German Confederation; : eastern and southern boundaries of the German Confederation; 4, boundaries of Russia, Prussia, and Austria beyond the territory c the German Confederation.

FIG. 7—The "oceanic-continental" frontier. 1, present western boundary of Germany; 2, canals.

FIG. 8—The frontier of Latin and of Greek Christianity (heavy line). 1, western limit of the Mongol Empire; 2, northern limit c the Turkish Empire; 3, eastern limit of solid German settlement; 4, decisive contests with Huns, Magyars, Mongols, and Turks. 5–; routes of aggression: 5, Huns, Mongols, etc.; 6, Turks; 7, Hitler.

gateway is the master of the huge continental "Heartland" that stretches from the Elbe to the Amur and is inaccessible to sea power.[2]

The Rhine-Rome Axis

Germany, which originated as the eastern outpost of the West, has become more and more part of the East as its center of gravity has moved in that direction. The Holy Roman Empire of the German Nation, as it was called, developed along the old Roman frontier on the Rhine but aimed southward toward the city of Rome (Fig. 9). In the time of the Saxon and Salian emperors (962–1125) the cities of the empire most important politically and commercially as well as most populous, such as Aachen, Cologne, Frankfurt, Mainz, Worms, Speyer, Strasbourg, Basel, Dijon, and Lyons, lay along the highroad of the Rhine and on the approaches to the Rhone Valley, which, at that time, formed an integral part of the "Reich." If we draw a connecting line between them and extend it southward, a "Rhine-Rome axis" emerges as the life line of the Holy Roman Empire. Across the Alps there was a choice of several passes for the armies of the knights of the North and the covered wagons of traders. The ways parted in Basel, to join again in Milan and lead to Piacenza and thence, along the ancient Via Aemilia, to the Eternal City. The rulers of the North were bent on achieving the sanctification whose supreme symbol rested with the Holy See.

The commercial center of the time lay outside the "Reich" to the west, in the fairs of the Champagne near Paris, where the products of the Mediterranean countries were exchanged for those of the North. The connecting lines to the East—to Bremen, Magdeburg, Bamberg, Regensburg, and other places—were still in their first stages of development in the tenth and eleventh centuries.

The Rhine-Rome axis remained the center of gravity in the high Middle Ages, the period of the Hohenstaufen emperors (1138–1254; Fig. 10). But a subtle change took place. The Hohenstaufen domain lay on both sides of the Rhine, with its larger part on the east bank, in the duchy of Swabia. The possible ways of crossing the Alps increased: a practicable route through the Schöllenen gorge north of the St. Gotthard was opened in the thirteenth century; the Brenner Pass came more and more into use as the Southeast grew to equal the Southwest in economic and political weight; still farther to the east, the Pontebba Pass, and a little later (in the fourteenth century) the

[2] Sir Halford J. Mackinder: The Geographical Pivot of History, *Geogr. Journ.*, Vol. 23, 1904, pp. 421–444; *idem:* Democratic Ideals and Reality: A Study in the Politics of Reconstruction, New York, 1919.

neighboring Predil Pass, assumed a heightened importance. The slow but steady eastward shift of the center of gravity also made itself felt north of the Alpine ranges: Nuremberg and Augsburg came to rival the cities on the Rhine and in the later Middle Ages surpassed them as commercial and political centers as well as in population. Finally, Frederick Barbarossa's Crusade to the Holy Land (1189) followed the Danube Valley instead of the seaway through the Mediterranean.

The Rhine-Danube Axis

The picture changed completely after the downfall of the Hohenstaufen. In the period of the Luxemburg and Habsburg emperors (1273–1740) Rome ceased to be a political goal (Fig. 11). The political axis swung sharply from north-south to west-east: the Rhine-Rome axis was replaced by a Rhine-Danube axis. It was reinforced by the financial axis of the time, which connected Augsburg and Vienna. Moreover, the main trade route, although still oriented north-south, ran far east of the Rhine, from Venice via Augsburg and Nuremberg to the North and West. In the fifteenth and sixteenth centuries the domain of the German Habsburgs occupied the whole Southeast of the "Reich." The domain of the Spanish Habsburgs, though still occupying large parts of the western frontier from the Netherlands to Milan, formed a broken wall of scattered pieces.

The Seventeenth and Eighteenth Centuries

The pressure that was forcing the empire toward the east became more pronounced after the Thirty Years' War (1618–1648; Fig. 12). This pressure was exerted by the combined forces of absolutistic prince and independent merchant in an antifeudalistic coalition. Germany was prevented from sharing in the early stages of this development as a consequence of the Treaties of Westphalia (1648) and the subsequent treaties of the seventeenth century, which cut Switzerland (1), Alsace and part of Lorraine (2), and the Dutch Netherlands (3) out of the body of the "Reich" and ceded the mouths of the Weser (4), the Elbe (5), and the Oder (6) to the kings of Sweden. The commercial metropolis of the time, Amsterdam, now lay outside the borders of the "Reich." A glance at Figure 12 shows what this meant in the age of colonial expansion then opening up: Central Europe was effectively shut off from participation in the exploitation of colonial wealth. Trade routes and political routes diverged in Europe, and the gap between the accompanying ideologies of money power and military domination widened at the same time. The German Habsburgs, frustrated in the West, looked for compensation in

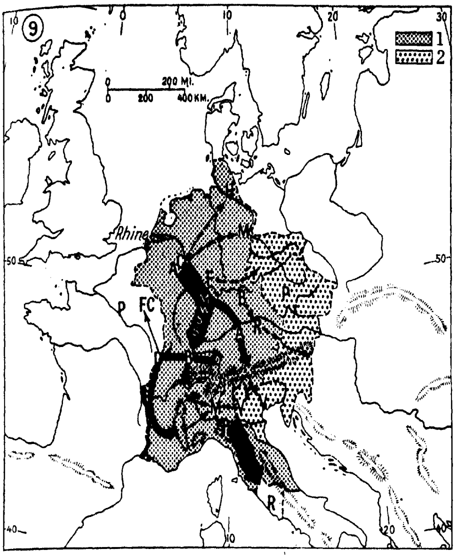
the East. The Turks, who had attacked Vienna several times, were repulsed for good in 1683. Shortly afterward, the armies of Prince Eugene swept through Hungary and gained an inland empire for the Habsburg crown.

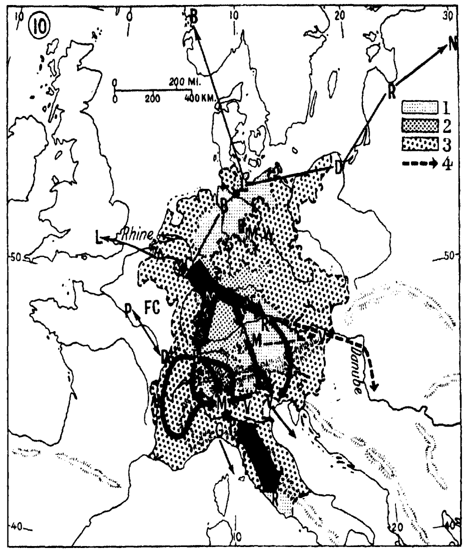
Meanwhile, North Germany had developed more or less independently. Before the Industrial Revolution the technical equipment for trade and war was inadequate for the administration of widely separated regions. The emperors of the Middle Ages could not fix their attention on Rome or the Danube and hold sway over the North at the same time. Hence for a while the North fell under the control of local powers such as the Hanseatic League, with its center in Lübeck and its trading stations scattered from Novgorod to London and Bergen (Fig. 10)—a network of commercial domination bound to crumble in the face of the competition of "national" merchants backed by strong governments.

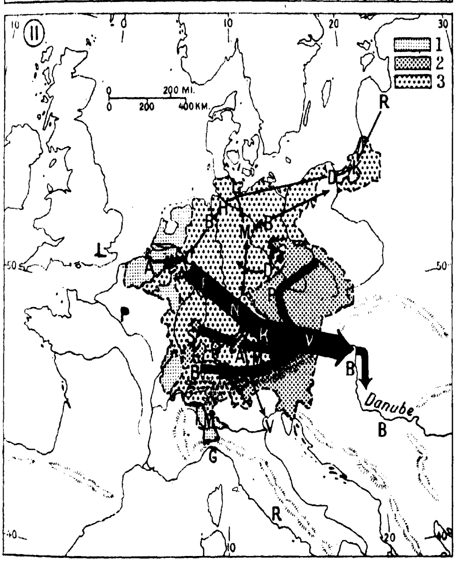
The Habsburg-Hohenzollern Contest

Which of the competing land powers would ultimately rule the North German Plain remained undecided for centuries. The regions east of the Elbe were long in the process of colonization, groping for a proper balance of power. For a while (twelfth century) the Guelph opponents of the Hohenstaufen combined the southeastern duchy of Bavaria with the northern duchy of Saxony (Fig. 10). But just as Austria was developing separately from Bavaria in the South, so Brandenburg developed separately from Saxony in the North. From 1423 until the time of Frederick the Great, two larger "electoral" states competed for dominance in the North, the Wettin state in Thuringia and Upper Saxony and the Hohenzollern state in Brandenburg and Prussia (Fig. 12). By the end of the seventeenth century Brandenburg-Prussia had acquired scattered possessions across the North German Plain, and in the eighteenth century the conquest of Silesia from Austria (1740–1763) by Frederick the Great made Prussia master of the entire Oder Valley. Saxony was thus prevented from expanding eastward and Austria shut out from any influence in the North. The political axis turned sharply to the east, its north and south ends, Berlin and Vienna, in different hands and the center in Breslau and Prague fiercely contested (Fig. 13).

For the time being the struggle between North and South remained at a stalemate. However, Austria, with a weak anchorage in the shapeless "Reich," could barely maintain herself on the defensive, while Prussia, firmly entrenched on the North German Plain, emerged as a first-rate power. Cultural revival as well as political leadership in the eighteenth century stemmed from the Northeast, and the combined forces of nationalism,







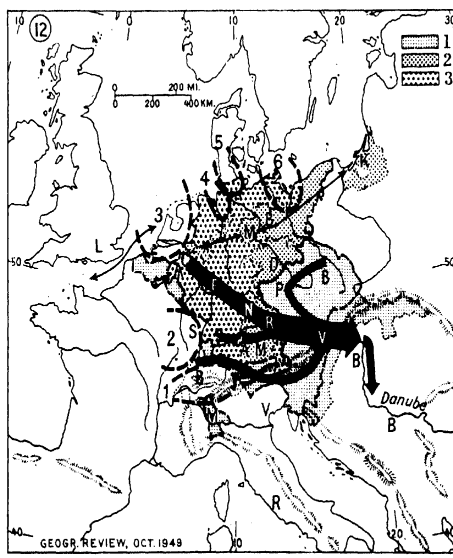


FIG. 9—The Rhine-Rome axis (early Middle Ages). 1, the Holy Roman Empire; 2, colonial extensions of the Holy Roman Empire; FC, Fairs of Champagne.

FIG. 10—The Rhine-Rome axis (late Middle Ages). 1-3, the Holy Roman Empire: 1, principal Guelph territories; 2, principal Ghibelline territories; 3, other states of the Empire. 4, route of Frederick Barbarossa's crusade.

FIG. 11—The Rhine-Danube axis (fifteenth and sixteenth centuries). 1-3, the Holy Roman Empire: 1, territories of the Spanish Habsburgs [spelling preferred by author]; 2, territories of the Austrian Habsburgs; 3, other states of the Empire.

FIG. 12—The Rhine-Danube axis (seventeenth and eighteenth centuries). 1, Habsburg territories; 2, Wittelsbach, Wettin, and Hohenzollern territories; 3, lesser German states. For figures on map see explanation in text.

romanticism, and racialism in Germany, from Herder to Wagner, were of Northeast German origin.

THE NINETEENTH CENTURY

At the Congress of Vienna (1814–1815) Austria gained the leadership of the German Confederation in name only. So much had Austria become a Southeast European power that she did not seek restoration of her former possessions on the upper Rhine. Prussia, on the other hand, had turned her face westward—decisively in taking possession of the Rhineland (1815) (Fig. 14). Soon there arose common interests (*commercium*) and intermarriage (*conubium*) between the Prussian landed aristocracy, bureaucracy, and Army leadership on the one hand and Rhenish big business on the other. This "unholy alliance" has provided the only effective ruling class in Germany for more than a century—and it is doubtful whether National Socialism has greatly changed the picture.

Again, the map depicts more than political relationships; it suggests social forces. It should be recalled that Bismarck crushed the opposition of the Left Wing Liberals, the Socialists, and the Catholics. By winning over the moneyed interests of the Rhine and the Ruhr he isolated democratic Baden and Württemberg; by excluding Austria from the North German Confederation in 1866 he isolated Catholic Bavaria. After 1871 the Königsberg-Berlin-Cologne axis ruled supreme, with Austria-Hungary and Italy as allies of the new "Reich."

From a northwest-southeast direction the political and economic axis had now swung conclusively to the northeast. It was, however, firmly tied to the south-north courses of the North German rivers: to the Oder between Stettin and Breslau, to the Elbe between Hamburg and Leipzig, and to the Rhine between Cologne and Strasbourg. From Hamburg, a way was opened to colonial expansion; the Ruhr coal district around Essen was connected with the complementary iron-ore region of Lorraine. Agrarian and Catholic southern Bavaria, which still found its main orientation along the Danube, was tied to the North by its Protestant and more industrialized districts of Franconia and the Rhenish Palatinate. Richard Wagner's residence in Bayreuth was symbolic of this bond of Pan-Germanism.

The unity of the *Kleindeutsches Reich* came in the wake of technical developments (Fig. 16). As compared with France (Fig. 17), Germany lacks a natural unity. All the great rivers of Germany flow from south to north with the exception of the Danube, which flows from west to east, and the Main, which flows from east to west. The Main, however, is a tributary of the

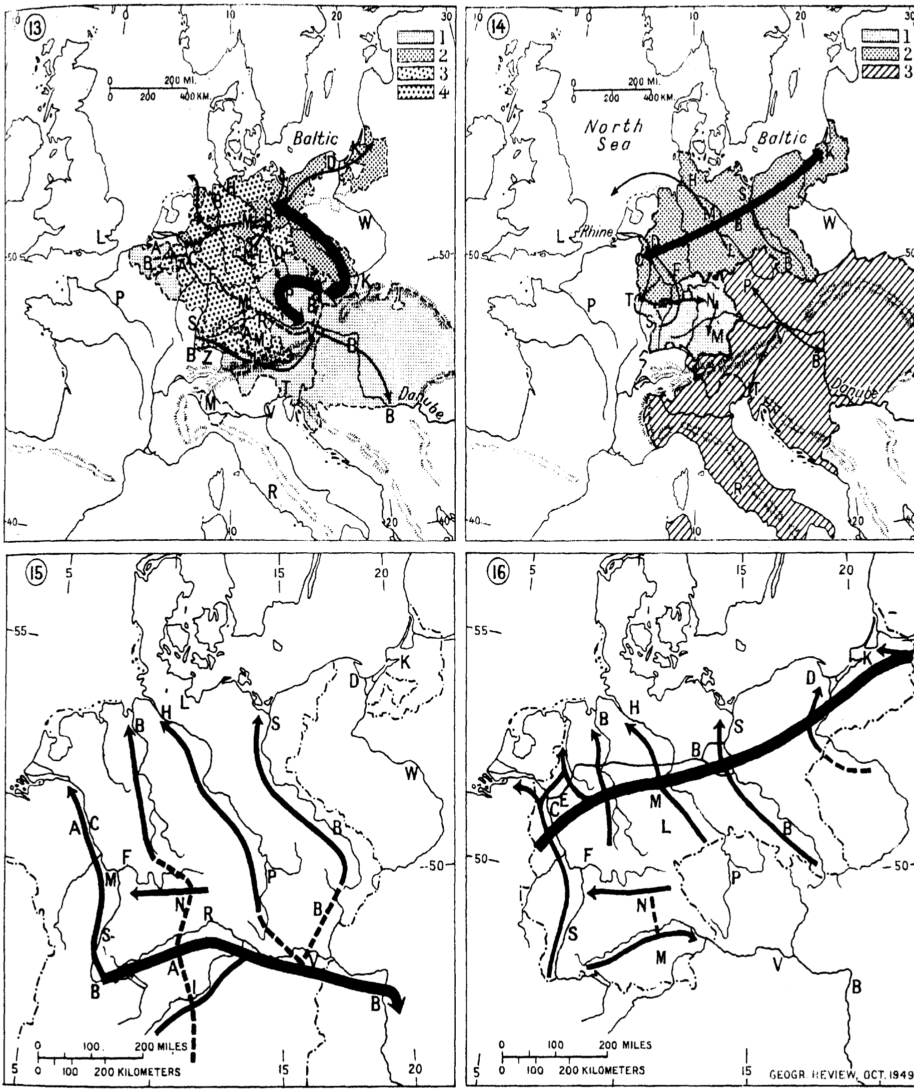


FIG. 13—The Habsburg-Hohenzollern contest. 1, Habsburg territories; 2, Hohenzollern territories; 3, Wittelsbach and Wettin territories; 4, lesser German states.

FIG. 14—The Hohenzollern axis (late nineteenth century). 1, South-German states; 2, Prussia and other North-German states; 3, allied states (Austria-Hungary and Italy).

FIG. 15—The Habsburg Empire, based on the Danube.

FIG. 16—The Hohenzollern Empire, based on the North German Plain.

Rhine and thus shares in the general trend toward the North Sea coast. Nevertheless, a loose coherence was maintained in the old "Reich" under Habsburg dominance as ruled from Vienna (Fig. 15). The Danube region functioned as a supporting frame, holding together the river systems that trended from south to north. The headwaters of the Danube were linked with the Rhine by the Austrian possession of Breisgau; the Danube and the Main were connected by the two outstanding commercial centers of the time, Augsburg and Nuremberg. If Austria had succeeded in annexing Bavaria in the eighteenth century, as she repeatedly tried to do, she would have had direct access to these cities, and her position in central South Germany would have become so paramount that Prussia would have found it much harder to wrest the hegemony in Germany from her. Farther to the east, the river system of the Elbe, through the Moldau (Vltava) Valley, linked the Danubian South to the North, and the valley of the Oder was easily reached from Vienna by the March (Morava) Valley and the Moravian plain. But the threads were loosely woven.

Things were entirely different in the Hohenzollern Empire. The steamship increased the importance of the harbors on the North Sea and Baltic coasts, coal deposits concentrated heavy industry on the lower Rhine, inland waterways linked the parallel river valleys, and the coming of railroads provided still more effective west-east connections across the North German Plain (Fig. 14). A band of iron rails had tied North Germany together even before a bond of blood was added through the victorious wars of 1864, 1866, and 1870.

Unification under Hitler

However, there was a serious flaw in the system—Bavaria. The Bavarian population is closely related to the Austrian. Both countries lie south of the old Roman-barbarian frontier, within the Roman culture area; they are linked together by the Danube. Hence the severing of the political tie with Austria caused resentment, particularly when industrialization was foisted on the precapitalistic Bavarian society. Adolf Hitler, who was born on the boundary where the break had occurred, set the tremendous force of his fanaticism on the task of removing the barrier between Bavaria and Austria, combining the Danube axis with the North German axis, and turning Munich and Nuremberg into the focal points of a new combination designed to fortify German unity more strongly than ever before.

Hitler's unification, like Bismarck's, seemed attainable only in opposition to France as the exponent of the "West." France and Germany were opposed in many respects. France was heir to the Roman tradition; Germany was

Romanized only in part, with the focus of leadership shifting steadily toward the east. France knew that German unity would shatter her position in Europe. Geographically, however, France long held an advantage in her greater natural unity. France has only one geographical center, the le de France, or, better perhaps, the circle Paris-Orléans (Fig. 17). The valley of the Loire leads from Orléans toward the west, south, and southeast; the valleys of the Seine, the Oise, and the Marne lead from Paris toward the English Channel, Belgium, and the Rhine, and likewise toward the southeast, into the valleys of the Saône and the Rhone. The lines of French "oceanic" expansion point toward the northwest, west, and south; the lines of "continental" expansion point wholly toward the territory of the *Reich*. Louis XIV and Napoleon I led their armies in that direction, and another, if short-lived, triumph of French continental expansion was marked by the peace treaties after the First World War.

The Europe of "Versailles," like Napoleon's Europe (Fig. 18), meant the Rhine frontier for France, realized in the demilitarization of the left bank of the Rhine. Furthermore, "Versailles" meant a system of defensive alliances for France in Eastern Europe, with Poland, Czechoslovakia, Yugoslavia, and Rumania. This system of alliances was intended to surround Germany and Hungary with watchdogs and keep Austria and Italy from joining a German-led combination. Prague became the second capital of a greater France. If necessity should arise, the French Army could use the *Saargebiet* as a springboard from which to pierce South Germany's "waistline" through the Rhine and Main Valleys and effect a junction with Prague.

This system of alliances foreshadowed the countermoves Germany was to make as soon as she had regained self-confidence under the stimulation of aggressive leadership. The Rhineland and the *Saargebiet* were reoccupied, with the result that a French thrust toward the German flank along the Rhine became much more difficult. The Rhine-Rome axis of the early Middle Ages reappeared as the Berlin-Rome axis of our time, with Munich as a geographic and political center. Austria came under Italian influence, and this, though for a time it seemed to keep the Germans at bay, actually served to invite German penetration. After the incorporation of Austria in 1938, German countermoves swiftly turned into a major attack. Czechoslovakia and Yugoslavia found themselves encircled. Poland and Rumania, allies of France still farther to the east, were hopelessly separated from effective help from the West and, since they were reluctant to throw themselves into the arms of the Russians, were wholly at the mercy of German aggression. All these moves frustrated the plan of the French General Staff to reach Prague through

the Main Valley and by thus separating the South from the North to endanger simultaneously Hitler's two lines of expansion (Figs. 18 and 19). The surrender of Bohemia was fatal.

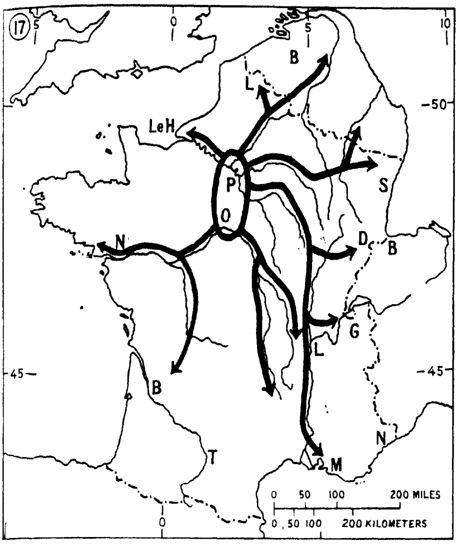
The spring of 1939 found Hitler in possession of the strategic lines of his Habsburg and Hohenzollern predecessors and hence in a position far more powerful than that of Bismarck's *Kleindeutsches Reich* (Fig. 19). The Rhine frontier was protected by the Westwall, or Siegfried line, as by a shield covering the back of a fighter. The southeastern line of expansion, from Bavaria and Austria along the Danube Valley toward the Balkans and the Black Sea, was protected on its flank by Bohemia and Slovakia, and Hungary could be used as a bastion for further advance. The northeastern line, across the North German Plain, had already been extended toward the valley of the Vistula at the time of the Polish partition and, with Bohemia in German hands, could be prolonged even farther. Hitler had also begun to move the industrial center of gravity from the west, where it was too dangerously near a vulnerable frontier, toward a more secure region farther in the interior of the new empire (Fig. 19).

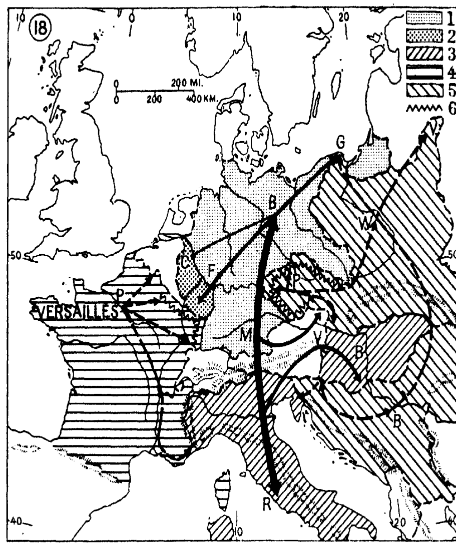
Thus by 1939 German unity in Central Europe and German paramountcy in Eastern Europe seemed safely established. The hegemony of the colonial East in Germany over the Romanized West had been confirmed once more, and the previously hostile elements, Bavaria-Austria and Brandenburg-Prussia, had been forcibly combined. German power had reached a high peak, and the domination of the world by the newly established "master race" seemed close at hand.[3]

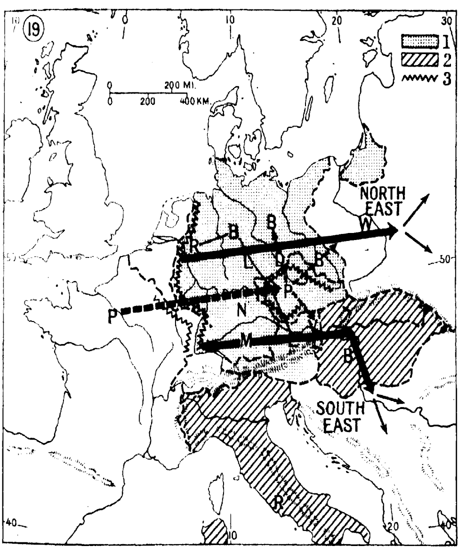
The Present Alignment

The dream of a German-imposed European unity has vanished in defeat. The great powers of the East and the West have partitioned Europe into zones, and the major line of division once more runs through German territory (Fig. 20). The demarcation line separating the Western and Eastern zones of occupation in Germany and Austria follows almost exactly the German-Slavic frontier of the early Middle Ages (Fig. 9). Of such immensity was the Slavic victory that it has wiped out at one stroke more than a thousand years of history. In the northeast, the former Prussian border provinces of Silesia, East and West Prussia, and Pomerania are now incorporated in Poland and almost empty of German inhabitants, and territories such as Mecklenburg, Brandenburg, Thuringia, and Saxony that, though situated on

[3] Derwent Whittlesey, with the collaboration of C. C. Colby and Richard Hartshorne: German Strategy of World Conquest, New York and Toronto, 1942.







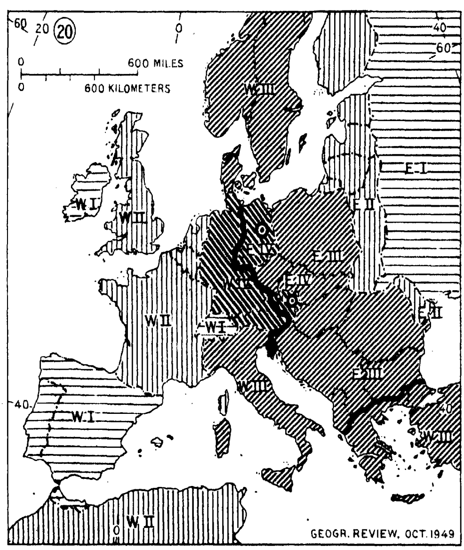


FIG. 17—The centralized character of France.

FIG. 18—The Berlin-Rome axis. 1, Germany minus the Rhineland; 2, the demilitarized Rhineland; 3, Italy and Hungary; 4, France; 5, allies of France; 6, fortifications.

FIG. 19—Central Europe in 1939. 1, Hitler's Germany; 2, Hitler's allies (Hungary and Italy); 3, fortifications; heavy solid arrows, Hitler's lines of attack; heavy broken arrows, contemplated French lines of advance.

FIG. 20—Europe after World War II (see text for explanation).

ancient Slavic soil, are clearly German, are occupied by the Russian Army and are under the political sway of Russia. In the center, Czechoslovakia has rid herself of her German minority and politically is also in the Russian grip. In the southeast, likewise, it is mainly those parts of Austria which were Slavic in the early Middle Ages that are today occupied by the Russian Army. The two German-speaking capitals of Central Europe, Berlin and Vienna, although administered jointly by the Western powers and Russia, lie well within the Eastern zone of occupation.

The political alignment of today is suggested by Figure 20. The Soviet Union as comprised within its boundaries of 1939 forms the core of the East (EI). The core of the West consists of Great Britain, France (including French North Africa), and the nations of the Benelux Union—that is, the countries that have entered into the North Atlantic Security Agreement with the United States and Canada (WII). Secondary areas, three on each side of the primary demarcation line, tend to mitigate the conflict somewhat. To the east these are, first, the areas annexed by the Soviet Union during World War II and Finland, in the main territories of non-Russian population that were once parts of the czar's empire (EII); second, the western Slavic nations of Poland, Czechoslovakia, Yugoslavia, and Bulgaria, and the non-Slavic but Communist-dominated Hungary, Rumania, and Albania (EIII); and third, the Russian-occupied zones of Germany and Austria (EIV). Correspondingly, to the west appear, first, the neutral nations of Eire and Switzerland, both clearly Western in orientation, and the Fascist relics of Portugal and Spain (WI); second, Scandinavia, Italy, Greece, and Turkey, all of which either are participating in the Marshall Plan or are otherwise tied to the West (WIII); and finally, the zones occupied by the Americans, British, and French in Germany and Austria (WIV).

General Conclusions

It may be revealing to compare the West and the East as they appear today with the emerging West and East of medieval times and later (Fig. 21). The Carolingian Empire (*ca.* 814), which represented the unity of Christian Europe in the early Middle Ages, was centered on the Rhine and Rhone Valleys, within a circle including Aachen, Frankfurt, Geneva, and Paris. From this core political, commercial, and cultural influences were disseminated during the subsequent millennium. The core of the East was the region of Moscow, the heart of the Russian river system, and Muscovite expansion had merely to follow the river courses. The routes to the west cross the Soviet boundary of 1939, a line that may be taken as defining almost

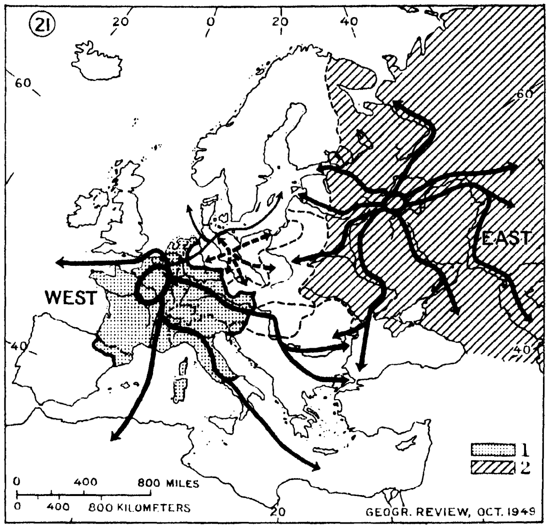


FIG. 21—The European power fields. 1, Carolingian Europe; 2, Muscovite Europe; lines of expansion from core areas are suggested by solid lines; lines of expansion from the center are suggested by broken lines.

precisely the western limit of indisputably Russian territory. The two great sociopolitical "fields" of East and West thus stand out, and between them is a vast region of twilights, uncertainties, and unresolved conflicts. This is the "shatter zone" of Sir Halford Mackinder, the zone where two world wars have broken loose and where lies the greatest danger of a third.

One area, however, that Mackinder assigned to the West might better be included in the shatter zone. This is Northeast Germany east of the Elbe and the Saale, comprising, at this date, the Russian zone of occupation in Germany and the western, formerly German, provinces of Poland. Together with central Poland and Czechoslovakia, this area, if politically united, is ideally situated for a far-reaching domination. This is why Hitler tried so desperately to Germanize it quickly and decisively by genocide. For the same compelling reason, Soviet Russia is centering her best efforts there. The Berlin crisis has not come about by whim or fancy.

How shall this crisis be solved? Should we drive for a united or a divided Germany? If the occupation forces are withdrawn and Germany is united, will it gravitate toward the East or toward the West? If it is to remain divided, should it be so in sovereign fashion, or should the occupation continue? No attempt can be made here to answer these questions, but consequences likely to flow from either action may perhaps be suggested.

Recently, Professor Max Beloff of Oxford, England, has voiced the opinion that "the only possible policy is to abandon the whole partition idea; to set up a single German government, to evacuate Germany, and to leave Germany outside both Western Union and Soviet Europe."[4] To judge from the historical maps presented here, this would seem a dangerous illusion. The area called Germany cannot realistically be regarded as a power vacuum.

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[4] Max Beloff: If We End the Occupation of Germany, *New York Times Mag.*, Nov. 7, 1948, Sect. 6.

To be sure, the German Nationalist movement, which is as vigorous as ever, will strive to re-establish the German power field as the focus of dominance in Europe against both the Eastern and the Western fields, now deadlocked in the center of the continent. But it can do so only in temporary alliance either with the West against the East or vice versa. If the Russians advocate a united Germany, it indicates their belief that the Berlin-Cologne axis of dominance will be quickly restored and that those who are to be the masters in this area will align themselves politically and economically with Russia. To Western Europe, the loss of the Danube basin and the Baltic rimlands is serious enough, but the loss of the Rhine Valley, the Ruhr basin, and the North Sea ports would be fatal. Neither France and the Benelux countries, nor Italy, nor Scandinavia could withstand the pressure of a Sovietized Germany. Conversely, the inclusion of Eastern Germany and Austria in the West would tip the balance of power, now so delicately poised, in favor of the West. Czechoslovakia, Hungary, and Poland would be irresistibly attracted. Hence, in either case, war would be imminent.

Following precedents of the Napoleonic and Bismarckian eras, Russian foreign policy seems now resolved to support the revival of German nationalism and a centralized German government. America should not follow along this line. The continued division of Germany, under a regime either of occupation or of independence, may not be the ultimate word of history but seems more conducive to the maintenance of peace at the present moment. In this event, some form of joint occupation of Berlin and Vienna, together with the international administration of Trieste, might be continued, if done with the clear understanding that a perpetual source of friction is thereby also continued and that an effective international machinery must be set up to cope with it. This would confront a permanent United Nations Mediation Service and Police Force with a most challenging task. If some such machinery cannot be constructed and yet peace is to be maintained, elimination of the source of friction through establishment of a clear-cut line of division between the Eastern and Western spheres of influence in Europe might be contemplated. The future of Vienna and Trieste would then have to be considered along with the problem of Berlin. Although a truly united Europe would have to reach to the Pripet Marshes and the mouths of the Danube, the stabilization of the *status quo* along the German-Slavic frontier of the Middle Ages might turn out to provide a working compromise. In this case, Western Europe, again, would find its center of gravity around the Mediterranean Sea, and the development of Africa ~~and~~ the Middle East, to replace Eastern Europe, would appear on the horizon as a foremost task.

TOWARD AN APPRAISAL OF WORLD RESOURCES
NEW VIEWS OF CONSERVATION PROBLEMS

GILBERT F. WHITE

THE balanced appraisal of world resources, which is the only solid basis for an answer to the currently perplexing question of population outdistancing resources, is slowly taking shape, but it will be long in assuming clear outlines. This is revealed in the first world effort to assess resources, made by more than six hundred scientists who took part in the United Nations Scientific Conference on the Conservation and Utilization of Resources from August 17 to September 6 at Lake Success.

In 500 papers setting forth the experience of 50 nations the scientists reported on their recent efforts at conservation of resources and shared their problems of technology and social action that urgently cry for solution. Although the Conference was unfortunately lacking in representatives from some major nations—principally Germany, Japan, and the Soviet Union—it marked a useful step in the direction of resources appraisal. It was the initial canvass of conservation problems on a world scale, and it was long overdue.

Gifford Pinchot and Theodore Roosevelt made plans for such a gathering to be held in The Hague in 1909, but the plans were halted by William Howard Taft, and for one reason or another the project has been delayed 38 years.[1] In 1947 the Economic and Social Council of the United Nations began plans for a conference, with the explicit understanding that it was to be concerned solely with the exchange of ideas and experiences and was not to be policy-making. The emphasis on scientific reports to the exclusion of policy-making resulted in peripheral treatment in the basic papers of many of the troublesome issues of international policy relating to soils, water, and minerals but did not prevent the papers for plenary sections from dealing with policy. It also removed a major incentive for the collection and reporting of uniform estimates of resources and their depletion.

The proceedings of the United Nations Conference therefore fall far short of presenting either a comprehensive inventory of world resources or a searching consideration of the public policy necessary to deal with dwindling reserves and with what apparently is an increasingly unbalanced ratio of

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[1] Gifford Pinchot: Breaking New Ground, New York, 1947, pp. 366–372.

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population to resources. The full collection of technical papers will ultimately be published by the United Nations. These papers, together with the proceedings of the First Inter-American Conference on Conservation of Renewable Natural Resources (held in Denver in September, 1948),[2] provide the most nearly global view of resources that we have yet enjoyed. Indeed, the two sets of proceedings are crowded with descriptions of scientific surveys and investigations that in some degree bear on conservation policy.

From these proceedings and from the other recent publications reviewed in this article it is possible to identify a few major themes that run through the current scientific thinking in the field of conservation.[3]

Population and Food Supply

The question whether or not world population is outrunning world resources at a critical rate, about which William Vogt and Fairfield Osborn have written and spoken so provocatively during the past two years, has become the subject of a somewhat illuminating public controversy. In the second plenary session of the United Nations Conference the issue was drawn by Osborn:

> Who can say that the question of population pressures is not inextricably interwoven with that of the adequacy of renewable resources? In considering the problem in the light of historical experience one is forced to the unhappy conclusion that up to the present time no really satisfactory answer has been found. The failures of the past have not been so much those of lack of knowledge as of lack of its sustained application.[4]

Several efforts have recently been made to outline this question as a guide for public thinking. One is a highly readable pamphlet in the Foreign Policy Association's Headline Series by C. Lester Walker,[5] who states the major arguments in popular and undocumented form. The United Nations Educational, Scientific and Cultural Organization has selected "Food and People" as the public-discussion topic which it is sponsoring for the autumn of 1949. It begins a series of pamphlets with a challenge from Aldous Huxley that "the world's underlying population crisis can only be relieved through the

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[2] In press.

[3] Outstanding recent publications on conservation before 1949 were reviewed by Wilma Belden Fairchild in "Renewable Resources: A World Dilemma," *Geogr. Rev.*, Vol. 39, 1949, pp. 86–98.

[4] *U. N. Conference* (*abbr., U.N.Conf.*). Fairfield Osborn: The World Resources Situation. (Papers presented at the United Nations Scientific Conference on the Conservation and Utilization of Resources were distributed in preliminary, mimeographed form before the conference. These have been used in the preparation of this article. They are, however, subject to change before the final proceedings are published.)

[5] C. Lester Walker: Man and Food: The Lost Equation? *Headline Ser. No. 73*, pp. 3–53. Foreign Policy Association, New York, 1949. 35 cents.

adoption, by all nations, of a world policy, aiming at the stabilization of population at a figure at which the relationship between numbers and resources, numbers and the amenities of life, shall be most favorable." In reply to this, Sir E. John Russell asserts the "impossibility of setting any limit to the world's resources" and points out some of the great opportunities for increasing food and energy supplies through application of new advances in science.[6] L. Dudley Stamp[7] and G. S. H. Barton[8] have also contributed helpful popular summaries of the problem, drawing on their wide experience in world agriculture to note cautiously the possibilities of extending the cultivable acreage and increasing production on existing acreage. A longer summary, giving special attention to nutrition, has been written by Le Gros Clark.[9]

Agricultural economists and agronomists have been quick to find fault with the idea that the world's food-producing capacity, if not actually declining, is incapable of wide extension in the foreseeable future. Their approach is stated at some length in the symposium on "Freedom from Want" sponsored by the American Association for the Advancement of Science in 1946 and recently republished as a number of *Chronica Botanica*.[10] In this analysis, K. S. Quisenberry estimates, for example, that by the use of improved breeds of rice and better agricultural practices it would be possible to increase rice production in China and India so as to supply 58,086,000 additional people. John D. Black draws together the findings of Tolley, Salter, and others to state:

> The true picture of the population balance in the world is therefore not one of all the world sinking toward a food-subsistence level, but instead of one country after another working itself into a state in which the arts advance faster than the population, output per worker increases, and the country definitely begins to move toward its population optimum. . . .
>
> Countries like China and India . . . probably are already at their lowest possible limit, as that limit was defined earlier. But they are likely to rise from this level rather slowly at the start—even if they make mighty strides in agricultural technology and industrialization. The gains for a few decades will mainly take the form of less disease and misery and longer,

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6 Aldous Huxley and Sir E. John Russell: Food and People (Challenge and Reply). 8 pp. United Nations Educational, Scientific and Cultural Organization in cooperation with Science Service, Washington, D. C., 1949. 10 cents. These are reprinted from *Science News Letter*, Vol. 55, 1949, pp. 199–202 and 215–218.

7 L. Dudley Stamp: Feeding the World's Peoples, *Westminster Bank Rev.*, London, February, 1949, pp. 1–6.

8 G. S. H. Barton: The World Food Supply, *Canadian Geogr. Journ.*, Vol. 38, 1949, pp. 228–235.

9 F. Le Gros Clark: Feeding the Human Family: Science Plans for the World Larder. ix and 125 pp. (Sigma Introduction to Science, No. 11.) Sigma Books Limited, London, 1947. 7s. 6d.

10 E. E. DeTurk, edit.: Freedom from Want: A Survey of the Possibilities of Meeting the World's Food Needs. Pp. 207–283. *Chronica Botanica*, Vol. 11, No. 4, 1948. Chronica Botanica Co., Waltham, Mass. (Stechert-Hafner, Inc., agent in New York City). $2.00. References on pp. 244 and 268–269.

healthier lives. The accompanying rise in the ratio of production to maintenance ration will presently, however, begin to manifest itself in rising levels of living, and this in a few decades by declining birthrates. Unless this stage is presently reached, the gains will be lost and the countries will start backwards and downwards again away from their optima.

Another generalized approach is given by Richard Bradfield, Louis Bromfield, and Joseph J. Spengler in their contributions to the annual meeting of the Academy of Political Science in November, 1948, at which the topic was "Food."[11] Spengler gives a succinct picture of population pressures and potentials, using felicitously the term "coiled" for populations of high potential increase. Bradfield, speaking of the United States, says:

I feel confident that we can feed at least 50 per cent more people in this country than we are now supporting and I have every reason for thinking that, by the time we reach a population of 220,000,000, our agriculture shall have progressed enough to enable us to carry at least double our present population without any sacrifice in our standard of living and without any depletion of the productive capacity of our soils.

A more nearly complete economic critique of the whole Neo-Malthusian position is given by M. K. Bennett[12] of the Food Research Institute at Stanford, who, while conceding the possibilities of deteriorating food supply and of the unlikelihood of rapid improvement in production, concludes that a gradual improvement in national diets is possible. He examines the current pessimism regarding food supply in the light of the experience since the similar assertions of Sir William Crookes in 1898 and suggests:

The customary but spurious quantitative exercise—only 4 billion cultivable acres now, less than 2 acres per person, with 2.5 acres estimated to be required per person to provide a minimum adequate diet, and with population growing while soil is washed away—ought not to mislead. The possible product of the earth defies measurement even on the assumption of stagnant technology, and the assumption itself gains no support from history.

John P. Ferris[13] supplements this critique in a long review of "Road to Survival," which challenges Vogt at several points and gives a good deal of attention to industrialization as related to resources conservation in the light of the experience of the Tennessee Valley Authority.

A number of the students of population incline to the pessimistic view revealed at the International Congress on Population and World Resources in Relation to the Family held in England in 1948.[14] Notwithstanding a hope-

[11] "Food." iv and 123 pp. *Proc. Acad. of Political Sci.*, Vol. 23, No. 2, 1949. $2.50. References on p. 58 and pp. 49–50 respectively.

[12] M. K. Bennett: Population and Food Supply: The Current Scare, *Scientific Monthly*, Vol. 68, 1949, pp. 17–26; reference on p. 26.

[13] John P. Ferris: People and Natural Resources, *Mechanical Engineering*, Vol. 71, 1949, pp. 91–93.

[14] *Proceedings of the International Congress on Population and World Resources in Relation to the Family, Cheltenham, England, August, 1948.* xviii and 246 pp. Published for the Family Planning Association of Great Britain by H. K. Lewis & Co. Ltd., London, n. d. 10s. 6d. Reference on p. 37.

ful note sounded by Sir John Boyd Orr, the Congress strongly emphasized the need for positive government policies to control population increase and repeatedly called attention to the interrelation of population and resources policies. Thus Frank Lorimer says of the areas of large population potential:

A long transition period of gradual increase in production with concomitant acceleration of population growth, such as occurred within the European sphere of civilization, cannot be sustained in Monsoon Asia or Middle America without recurrent disaster and constant menace to the security of all nations. A more rapid transition to the effective control of fertility than occurred in Europe is imperative for any sustained and significant rise in real levels of living in Monsoon Asia and in other impoverished regions.

The most vigorous defense of the Neo-Malthusian position is to be found in the recent publications of Guy Irving Burch[15] of the Population Reference Bureau. Burch believes with Lorimer that only a restrictive population policy will prevent "a population explosion in Asia and Latin America." These arguments do not radically change the earlier statements of Burch and Pendell. The Friends of the Land have taken a vigorous interest in this discussion from the standpoints both of soil conservation and of healthy rural life. Russell Lord,[16] editor of *The Land,* makes his own appraisal of the situation in a recent issue of this periodical and calls attention especially to the reconciling of population policy and soil policy and to the strategy of arousing public support. There have been so many extreme statements on both sides of the question of dwindling resources that Lord's comments are refreshing:

As one of the earlier editors on the staff of the Soil Conservation Service, I know from experience that it is perfectly natural to take up one thing at a time and hammer away at that, as advertisers and propagandists do. First establish the threat of ruin; later, we'll talk about restoration—and so on. But that's wrong. As evidences of restoration multiply, it becomes unconvincing; and if we go on with this anomalous approach and attack, viewing with alarm and pointing with pride in the same breath and motion, we confuse the public, and have only ourselves to blame if they don't believe us.

ADVANCING TECHNOLOGY OF RESOURCES USE

Against the background of the debate over total population and total resources the reports at the United Nations Conference depict concrete advances in preserving and utilizing the known resources of water, land, forests, wildlife, and minerals. In all these fields technological progress has been substantial. Some of the reports show the perfection of new techniques;

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[15] Guy Irving Burch: How Many People Can the World Support? *Population Bull.*, Vol. 4, 1948, pp. 37–43.

Idem: The "Eat Hearty" Hoax? *ibid.*, Vol. 5, 1949, pp. 1–7.

[16] [Russell Lord:] The Conservation Crisis—Or Isn't It? A Review of the Evidence, *The Land,* Vol. 7, 1948–1949, pp. 524–532; reference on p. 529.

others provide an improved frame of thought for attacking difficult problems.

In the field of water development, the practicability of reclaiming sewage-plant effluent for industrial and agricultural use is reported in communications from Czechoslovakia and the United States. The City of Baltimore now sells 35 to 40 million gallons of sewage discharge daily to a steel manufacturing plant, thus opening up wide possibilities for meeting water needs through re-use at a suitable cost.[17] Smaller-scale uses of effluent for agriculture and fish culture are proving successful below Prague and Brno.[18] Large opportunities for expanding the irrigated acreage of cropland are under study or development in Egypt,[19] Java,[20] and Mexico,[21] though in all these areas the physical limit of expansion is clearly set by the amount of water and land available. It is encouraging to note that there is general recognition of the complex relationship between soil fertility and irrigation, a relationship which has been commonly neglected in many irrigated areas, and which now requires drastic measures to provide drainage and other means of moisture and salinity control. Pakistan reports that 20,000 acres of land are being lost annually through excess salinity.[22] The problem of sediment control and reservoir silting receives attention from several participants, including the participant from India, where the rate of reservoir silting has been markedly lower than in North America.[23] Sedimentation has also been the object of fruitful interagency cooperation in the United States.[24] The exchange of technical information on the sources, transport, and control of silt marks a hopeful step toward solving the still baffling question of silt in streams such as the Colorado. Among a number of valuable papers dealing with progress in torrent control and with the management of land and forests in relation to their influence on stream flow, the paper by Howard L. Cook[25] is helpful in drawing together judiciously the knowns and recognized unknowns affecting water movement to the stream channel.

In the field of land-use techniques, the rapid spread of soil-conservation measures is perhaps outstanding. Although not all participants could say

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[17] *U.N.Conf.* Abel Wolman: Utilization of Surface, Underground and Sea Water.

[18] *U.N.Conf.* Jan Zavadil: Control and Utilization of Polluted Waters.

[19] *U.N.Conf.* Abdel Aziz Ahmed: Recent Experience in Lift Irrigation and Drainage in Egypt.

[20] *U.N.Conf.* W. F. Eijsvoogel: Recent Developments in Indonesia.

[21] *U.N.Conf.* Antonio Rodriguez L.: Recent Developments in Irrigation.

[22] *U.N.Conf.* S. M. A. Butt and P. B. A. Salim: Soils and Water Control.

[23] *U.N.Conf.* A. N. Khosla: Special Techniques in Water Storage Conservation.

[24] *Proceedings of the Federal Inter-Agency Sedimentation Conference, Denver, Colo., May 6–8, 1947.* x and 314 pp. Edited and prepared for publication by the Bureau of Reclamation, U. S. Department of the Interior, Washington, D. C., 1948. Copies available for limited distribution.

[25] *U.N.Conf.* Howard L. Cook: The Effects of Land Management upon Runoff and Groundwater.

with T. S. Buie[26] that "more progress has been made in the development and refinement of physical methods of soil conservation within the past fifteen years than in the preceding 100 years," the evidence of perfection of new techniques such as stubble-mulch farming is impressive.[27] Stubble-mulch farming was first investigated in 1938 and within 10 years had been applied to some 21 million acres of land in the United States. No such rapid acceptance is reported for other countries, however. All the papers do show a readiness to consider soil conservation not in terms of a single measure, such as contour plowing, but rather as a combination of many measures suited to the conditions of soil, climate, and economy of each area. This is well demonstrated by Sir Harold A. Tempany in his survey of soil conservation in the British colonial empire.[28] He reviews each of the methods associated with earth structure or cultural practices and considers grazing control, agricultural systems, machinery, and legislation. On soil fertility he says:

> Soil fertility is intimately bound up with the conservation of the soil. A considerable amount of information has become available concerning methods by which this can be accomplished, but no prescription is, or can be, universally applicable under all conditions. Measures suited to particular areas have to be worked out on the spot by trial and error and the results applied in practice. Moreover many points are still obscure and require to be elucidated by research; this applies particularly to the role played by organic matter in tropical soils in its chemical, physical and biological aspects.

The same note of vigilance regarding the complications of applying any new measure to other environments and the difficulties of translating a single technical improvement into increased crop production recurs in other technical papers. The British farmer increased the number of farm tractors fivefold during 1939–1949, but at the present time he "finds himself with a reduced humus content of the soil which cannot be corrected by artificial means."[29] Although the grain industry of the Canadian prairies is relatively young and has been maintained by technical advances relating to wind erosion, plant diseases, insect pests, and increasingly productive crop varieties, there are indications that the prevailing cropping system may eventually have to be modified to include grasses and legumes.[30] Serious cautions are raised from

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[26] *U.N.Conf.* T. S. Buie: Physical Methods of Soil Conservation.

[27] *U.N.Conf.* F. L. Duley: Research and Soil Conservation.

[28] Sir Harold A. Tempany: The Practice of Soil Conservation in the British Colonial Empire. vii and 106 pp. *Commonwealth Bur. of Soil Science Tech. Communication No. 45*, Harpenden, England, 1949. 10s. 0d. Reference on p. 62. [Obtainable from Central Sales Branch, Commonwealth Agricultural Bureaux, Penglais, Aberystwyth, Great Britain.]

[29] *U.N.Conf.* W. H. Cashmore: The Effect of Mechanization on Soil Conservation and Farm Technique in Britain.

[30] *U.N.Conf.* E. S. Archibald: Cropping Systems as an Aid to Sustained Production.

Rothamsted against extravagant assertions of increased crop production by the application of fertilizer without careful field experiments.[31] Although substantial gains are reported in the control of plant and animal diseases and pests, the scientists are reluctant to make sweeping claims. The experience with the control of codling moth by DDT that led to large increases in the inroads of the red-banded leaf roller is only one example of the many complications involved in the new techniques.[32] Scottish experiments with improving the food conversion efficiency of farm animals show that "where feed resources are limited, control of disease will raise production only if overstocking is avoided," and that among dairy herds functional sterility, which may be caused by the feeding of "improved" grasses, is the largest single cause of wastage in production.[33] Sweden has taken long strides in the breeding of cereals, but it is estimated that the future annual increases in cereal production will just equal the increase in demand due to population increases over the next 10 to 20 years.[34] One of the imaginative suggestions for world strategy in meeting food needs comes from a New Zealand plant breeder, who asks whether the present resources of trained geneticists should not be redeployed to countries where plant breeding still finds "wide empty spaces" of underdeveloped land.[35]

Notwithstanding these complications, a number of dramatic proposals for national and international action that would in time increase crop production are set forth. They range from endorsement of the Food and Agriculture Organization's plan for an international catalogue of plant breeding stock to individual reclamation projects. Definite progress is reported for several schemes of improved crop rotation in the Belgian Congo, and for experiments in the use of alluvial lands which heretofore have been avoided by the natives but which with adequate health protection now promise much higher yields than the uplands.[36] The Netherlands is looking beyond the completion of the Zuider Zee project to a time when estuaries and tidal creeks along the shore of the country will be reclaimed.[37] From India comes a discussion of the possibilities of reclaiming large bodies of land outside the

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[31] *U.N.Conf.* E. M. Crowther: Field Experiments as the Basis for Planning Fertilizer Practice.

[32] *U.N.Conf.* P. N. Annand: Protection of Crops and Grasslands against Insects.

[33] *U.N.Conf.* Isabella Leitch: Efficiency of Different Classes of Farm Animals in Converting Farm Crops to Food.

[34] *U.N.Conf.* Å. Åkerman: The Improvement of the Yield of Cereals in Sweden Due to Plant Breeding.

[35] *U.N.Conf.* O. H. Frankel: Development and Maintenance of Superior Genetic Stocks.

[36] *U.N.Conf.* F. Jurion and J. Henry: Cropping Systems in the Equatorial Forest Region of the Belgian Congo.

[37] *U.N.Conf.* Ir. F. Hellinga: Opportunities for the More Effective Agricultural Use of New Lands.

traditional irrigation projects. D. R. Sethi[38] estimates that India has 10 million acres of cropland that has been abandoned because of infestation with *kans* or *hariali*, two weeds impossible to remove except with heavy tractor-drawn plows, now available for the first time. In addition, he estimates that 20 to 25 million acres of waste lands might be brought into cultivation at economic cost by means of comprehensive colonization, land clearing, and drainage.

Many other examples of these types of technological advance in agriculture might be cited. E. C. Stakman[39] has made an excellent summary of some of them in the United States. Equally significant developments in forest utilization, wildlife conservation, and mineral exploitation and conservation are described in the United Nations proceedings. They cannot be reviewed in detail here, but a few of the more interesting may be noted. Because the whole problem of settlement of the wet tropics is largely unsolved, contributions such as A. Aubreville's analysis of the tropical rain forest are challenging.[40] He suggests two schemes of cutting and planting to transform mixed rain forest into commercially useful stands in 50 to 100 years. From the Marine Biological Laboratory in New South Wales comes an estimate that the world's annual fishery production could be increased by 22 per cent over prewar production through the use of improved gear, better marketing facilities, and extension of the grounds.[41] Experiments in France and the United States indicate that underground gasification of coal is on the verge of economic exploitation. The Director of Britain's Colonial Geological Surveys concludes a survey of the outlook for future discovery of mineral resources with this summary:

> The next few years will see a great increase in facilities for investigating the world's mineral resources, as well as in research concerning new uses, and in finding substitutes for those minerals that are in short supply; in all these respects the outlook for mineral discovery has never been better. The final results of these great new investigations it would of course be hard to estimate, yet it may safely be anticipated that a number of important suspected concealed deposits will not be large, but that a very large number of medium and small deposits, both of export minerals and of those required for local use, will be brought to light. Finally, we may conclude that there is no foreseeable finality in mineral discovery, for the field continually widens with the general advance of knowledge.[42]

H. L. Keenleyside, Canadian Deputy Minister of Mines and Resources, agrees that "there is no serious and immediate over-all and irreplaceable

[38] *U.N.Conf.* D. R. Sethi: Land Reclamation.

[39] E. C. Stakman: Science in the Service of Agriculture, *Scientific Monthly*, Vol. 68, 1949, pp. 75-83.

[40] *U.N.Conf.* A. Aubreville: Silviculture of Mixed Tropical Rain Forests.

[41] *U.N.Conf.* Harold Thompson: Latent Fishery Resources and Means for Their Development.

[42] *U.N.Conf.* F. Dixey: Mineral Resources: Outlook for Future Discovery.

shortage of any essential mineral" but warns: "It is equally clear that the demand for mineral products is increasing at such a rate that unless there is a fundamental change in the economic fabric of human society, we will ultimately be faced with the exhaustion of many of our mineral reserves."[43]

One other recent publication in technology deserves mention. It is Glesinger's popular account of wood uses and wood technology.[44] After giving a general review of forest production and exploitation in the major regions of the world, it presents the chief possibilities for the use of wood sugar, cellulose, and lignin. It has clear and pleasing charts that help explain some of the elements of the unfolding wood technology, which promises to change the demand for timber in important ways.

Conservation Economics and Politics

If any one conclusion can be drawn from the broad panorama of technological research presented at the United Nations Conference, it is that accurate estimates of world resources—particularly as related to food production in land or water—are not now available, and that even if they were available they would be subject to so many qualifications that they would be largely meaningless. Scientific findings on land capabilities are too scattered to permit more than a few generalizations. Uses for areas such as the tropical rain forests or the southern continental shelves are known only vaguely. Although conservationists are ready to assert the interrelation of resources-management problems in every area, in only a few areas do they understand the physical relationships. But they are united in recognizing these relationships, and nowhere is there any doubt as to the need for pressing ahead with conservation practices.

Still another theme recurs again and again in the currently published statements. It is the recognition that the rate and degree of application of the most carefully tested technical improvements in conservation are determined by the patterns of economic life, and that changes in systems of farming or forest use come slowly and gradually at best. Political aid or control coupled with vigorous educational measures is essential to finding acceptance for wise conservation practices. The slowness of such measures is largely the reason for Vogt's skepticism regarding the practicability of meeting the world's food needs by increasing production. Their complexity is illustrated in every region and in every field of resources use. For example, a lively interest in supplementing farm food supplies by the cultivation of warm-

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[43] *U.N.Conf.* H. L. Keenleyside: Critical Mineral Shortages.

[44] Egon Glesinger: The Coming Age of Wood. xv and 279 pp. Simon & Schuster, New York, 1949. $3.50.

water fish in ponds is shown by reports from India, Indonesia, China, Japan, and the Philippines, and production of as much as 2000 to 4000 pounds per acre per annum is contemplated.[45] In commenting on the future, the Indian participant concludes:

I wish to impress on all administrators and research workers the absolute need for a new mental approach to the question of pond culture in relation to its role as a potential food-resource. Working in tropical countries, one is constantly and painfully made aware of the prejudices and conservatism among farmers and fishermen. Against this background, evolutionary methods of improvement and development should be followed, for I am convinced that passive-infiltration methods will achieve far more lasting effects than spectacular revolutions.

Norway's new national survey of forests shows an average increase of about 20 per cent in both volume and annual increment of forest growth over a 20-year period.[46] This is not, however, considered the most important aspect of Norwegian forest policy. Eide says that the removal of forest problems "from the technical into the social sphere has compelled all institutions and organizations dealing with forestry to look at these problems from a social point of view." Forward-looking forest policy in the British Commonwealth has unfolded with great slowness. The United Kingdom and the dominions are, in fact, considerably behind India and some of the colonies, mainly, it is said, "because higher policy in such countries is more largely dependent on public opinion."[47] The two government reports recently published on forest resources of the United States lay heavy weight on the crucial importance of public action and education in enforcing the known remedies for an annual cut that exceeds annual growth.[48] Their encyclopedic treatment of all phases of the forest situation makes them invaluable as source books for the study of forestry problems and of the relation of forests to economic organization and to recreation. The "Reappraisal" sums up the cut and growth ratio, proposes a flexible long-range goal, and states the present situation as a dilemma in which

the intrinsic needs of this country for saw-timber products are considerably greater than the present cut. Yet saw-timber drain already exceeds annual growth. To increase current output implies accelerating timber depletion and so hastening the day when drastic reduction in the

[45] *U.N.Conf.* Sunder Lal Hora: Management and Cultivation of Fresh Water Fish: Pond Culture of Warm Water Fishes.

[46] *U.N.Conf.* Erling Eide: The Practical Basis of Norwegian Forest Policy.

[47] *U.N.Conf.* H. R. Blanford: Forest Policy in the British Commonwealth of Nations.

[48] "Forests and National Prosperity: A Reappraisal of the Forest Situation in the United States." vii and 99 pp. *U. S. Dept. of Agric. Misc. Publ. No. 668,* 1948. 40 cents (for sale by the Superintendent of Documents, Washington, D. C.). Reference on p. 4.

"Trees." xiv and 944 pp. *Yearbook of Agriculture 1949.* U. S. Department of Agriculture, 1949. $2.00 (Superintendent of Documents).

use of timber products would be inescapable. To curtail output now so as to facilitate building up growing stock and annual growth would leave urgent needs (such as that for more housing) unfilled and might weaken the foundation for a high-level national economy. There is no wholly satisfactory way out.

The problem is believed to center mainly on private land, and on the small size of private holdings. A series of public aids to private owners are recommended, and the earlier but unaccepted plea for public control of cutting on private land is renewed.

The United Nations Conference papers on land problems repeatedly merge the technical with the social and economic. Many participants take the position set forth by L. J. S. Littlejohn[49] after describing the practices adopted to conserve the soil of Cyprus under present systems of land use. Long-term conservation of the soil will, he is convinced, "only be achieved if there is a radical change in the whole pattern of the agricultural and social system." This statement applies also to areas of disastrous erosion in such countries as Pakistan and El Salvador, where little corrective work is undertaken.[50] In his world survey of grazing-land management Clarence Forsling[51] arrives at similar conclusions and lays stress on corrections in tenure, nomadic systems, and farm credit as bases for improvement. Solutions cannot be worked out simply in terms of conservation practices or productivity data. Not only must farming systems be changed, but they must be changed in "management units." One distinguished economist even asserts:

Take any farm at random anywhere in the United States and work out for the owner a plan with its operator that promises to maximize its net return over even as short a period as five or ten years, and the chances are at least four out of five that this plan will build up rather than lessen the productivity of the farm.[52]

A survey of New England dairy farms is cited in support of this proposition, but other students are inclined to believe that public aid on a wider scale may be necessary to achieve stabilized farm fertility. Sherman Johnson[53] gives a useful series of cases, ranging from operators that could, and would, adopt soil-saving methods at increased income to operators, such as northern

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[49] *U.N.Conf.* L. J. S. Littlejohn: Soil Conservation in Cyprus.

[50] For a review of the El Salvador dilemma see J. Russell Smith, *Geogr. Rev.*, Vol. 39, 1949, pp. 159-163.

[51] *U.N.Conf.* Clarence L. Forsling: Relation of Sustained Livestock Production to Condition of Grazing Land.

[52] *U.N.Conf.* John D. Black: The Co-ordination of the Best Soil Management Practices into Unified Farm Management Plans.

See also William G. Murray, Earl O. Heady, and John F. Timmons: Economic Aspects of Soil Conservation Problems, *Journ. of Soil and Water Conservation*, Vol. 4, 1949, pp. 17-20.

[53] *U.N.Conf.* Sherman E. Johnson: Farming Systems in Relation to Soil Conservation.

Great Plains wheat farmers, for whom soil maintenance is not feasible if the land is used for crop production. For these latter he proposes a grant-in-aid program to underwrite a shift to soil-saving farming without sacrifice of income and with the land maintained as a kind of "contingency reserve" against later demands a national emergency might make.

In short, conservation measures are increasingly seen as physical techniques designed to meet the conditions of the local environment in such a way that they harmonize with the peculiar needs of the farm operator under whatever scheme of public aid and encouragement may be devised. The most challenging use of this broad concept has been made by Stephen Raushenbush[54] in his proposal of a comprehensive program to speed up conservation work in the United States. Being aware of the slow pace of the conservation activities of federal agencies, he argues that "we cannot ask for social responsibility toward our resources from people who cannot afford the obligations of conservation. But we can create a situation where they can afford to take on these obligations," and he proceeds to recommend the creation of a National Resources Corporation that would finance a series of repayable projects in soil, forest, and grassland conservation by issuing bonds. He also proposes four specific measures to conserve oil and gas. These recommendations were the focus of discussion of the Emergency Conference on Conservation held in Washington in April, 1949.

Unity in Land—Unity in Administration

No definite proposals for national or international action were made by the United Nations Conference. Yet the technical papers carry a persistent recognition that the needed work can go forward effectively only as there is international cooperation in information and control measures (insect control and fisheries management are especially important) and only as the work is administered locally so as to unify all relevant conservation measures for private or public management units.

Everywhere the governmental structure has failed to adapt itself to this concept of unified administration. The lack of integrated resources agencies is conspicuous wherever comprehensive river basin development is in prospect. International streams such as the Indus, Tigris-Euphrates, and Nile are especially handicapped. Full adaptation of government to the new concept will be long in coming, but if the recent output of reports on resources administration is a sign, the changes are beginning to take shape.

[54] Stephen Raushenbush: Our Conservation Job: A New Way to Obtain Soil and Range, Forest, Fuel and Energy Conservation. 64 pp. *Public Affairs Inst. Rept. No. 4*, Washington, D. C., 1949. 50 cents. Reference on p. 10.

On the national level, the findings and recommendations of the Commission on Organization of the Executive Branch of the Government, commonly known as the Hoover Commission, afford the first comprehensive appraisal of federal resources activities to be presented in many years.[55] The Commission's proposals, to which there were several major dissents, and which differ somewhat from the three independent committee reports on agriculture, natural resources, and public works, would give the United States a unified land-management agency and a unified water-development agency. In the words of the Natural Resources Committee:

Our country has reached a point in its development that calls for a new concept of the relation of natural resources to its economy. . . . To meet the needs of the future and to promote more orderly development and exploitation of the Nation's resources, as well as to guard the heritage of the people, the unification of the responsibilities and services of the Government dealing with such matters seems clearly called for.

The several committees could not agree on such questions as whether or not the new land agency should be located in the Department of Agriculture. They did agree on unification. They were critical of the lack of coordination and the costly competition among federal agencies as revealed in several of the special studies, such as Edward Ackerman's analysis of the Missouri Basin Program in the Natural Resources Committee's report. Some of these wasteful situations are now publicized by the Izaak Walton League.[56]

An equally comprehensive set of studies on the state level has been completed by six southeastern states with the aid of a grant from the General Education Board.[57] Research for each state was undertaken by a staff from

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[55] Organization and Policy in the Field of Natural Resources. Prepared for the Commission on Organization of the Executive Branch of the Government. [Hoover Commission Rept.] x and 244 pp. Government Printing Office, Washington, 1949. 50 cents.

Reorganization of the Department of the Interior: A Report to the Congress by the Commission on Organization of the Executive Branch of the Government. 94 pp. Government Printing Office, Washington, 1949. 30 cents.

Department of Works. Prepared for the Commission on Organization of the Executive Branch of the Government. viii and 81 pp. Government Printing Office, Washington, 1949. 25 cents.

Agricultural Functions and Organization in the United States. Prepared for the Commission on Organization of the Executive Branch of the Government. xviii and 112 pp. Government Printing Office, Washington, 1949. 30 cents.

[56] "Crisis Spots in Conservation." Looseleaf. Izaak Walton League of America, Inc., Chicago and Denver, 1949.

[57] Vera Briscoe, James W. Martin, and J. E. Reeves: Safeguarding Kentucky's Natural Resources. x and 224 pp. *Univ. of Kentucky Bur. of Business Research Bull. No. 14.* Published for the Bureau of Business Research and the Bureau of Government Research by the University of Kentucky, Lexington, 1948.

Lee S. Greene, Virginia Holmes Brown, and Evan A. Iverson: Rescued Earth: A Study of the Public Administration of Natural Resources in Tennessee. x and 204 pp. Published for the Bureau of Public Administration [of the University of Tennessee] ~~by~~ the University of Tennessee Press, Knoxville, 1948.

Robert Baker Highsaw: Mississippi's Wealth. x and 190 pp. Bureau of Public Administration, University of Mississippi, University, 1947.

the state university, and the whole study was organized so as to include roughly similar assessments of state administration of resources and its deficiencies. Although each state presents a different problem of unification, the proposed solutions are approximately the same.

An example of administrative problems in trustee areas is described in a recent publication on conservation in Micronesia, from which Laura Thompson concludes that a single civilian agency is needed there also.[58]

CONSERVATION EDUCATION

Public opinion being patently one of the obstacles to conservation measures, the addition of two new guides to the literature on the teaching of conservation in elementary and secondary schools is timely. Each book is published by a national nongovernment agency. Ward Beard[59] offers a guide to basic understanding in teaching; Vernon Carter[60] outlines the problem from the standpoint of ecology. Both volumes contain helpful suggestions for field trips, but neither attempts to deal in any detail with social aspects of conservation or with the complexities of physical relationships.

In a broader sense, the whole Neo-Malthusian controversy and the United Nations Conference are good conservation education. They are directing public attention to the implications of resources depletion. If they at times seem to offer new complexities instead of simple world statistics and equations, it is well. As the trend in government administration of resources would seem to indicate, although the need for vigorous conservation measures is relentless and difficult to exaggerate, the carrying out of those measures requires a highly flexible management that suits a distinctive combination of measures to each local environment of resources and of human life.

Christian L. Larsen: South Carolina's Natural Resources: A Study in Public Administration. xi and 211 pp. University of South Carolina Press, Columbia, 1947.

Joseph M. Ray and Lillian Worley: Alabama's Heritage. x and 186 pp. Bureau of Public Administration, University of Alabama, University, 1947.

Paul W. Wager and Donald B. Hayman: Resource Management in North Carolina. x and 192 pp. Institute for Research in Social Science, University of North Carolina, Chapel Hill, 1947.

[58] Harold J. Coolidge, comp.: Conservation in Micronesia: A Report on Two Conferences Held under the Auspices of the Pacific Science Board in Honolulu, T. H., and Washington, D. C., in April and May 1948. iv and 70 pp. National Research Council, Washington, D. C., 1948.

Laura Thompson: The Basic Conservation Problem, *Scientific Monthly*, Vol. 68, 1949, pp. 129–131.

[59] Ward P. Beard: Teaching Conservation: A Guide in Natural Resources Education. 144 pp. American Forestry Association, Washington, D. C., 1948. $1.50.

[60] Vernon Gill Carter: Man on the Landscape: The Fundamentals of Plant Conservation. xv and 129 pp. National Wildlife Federation, Washington, D. C., 1949. $1.50.

EMPRESA BORSARI

ITALIAN SETTLEMENT IN TIERRA DEL FUEGO

CHARLES B. HITCHCOCK

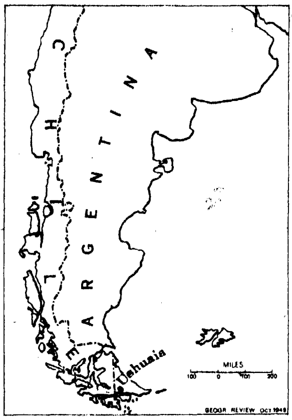


FIG. 1

ON October 25, 1948, an Italian motor ship from Genoa, Italy, arrived at Ushuaia, Argentine Tierra del Fuego, the southernmost town in the world. It brought a unique experiment in colonization—614 men, women, and children from the northern Italian provinces and 2300 tons of material for building a settlement and initiating its industrial development This experiment in foreign colonization had been brought about under agreement between the Argentine Ministry of Marine and private Italian interests, headed by Signor Carlos Borsari. The wholesale immigration was due both to the desire of the immigrants to escape from a war-torn homeland and to the wish of the Argentine government to develop Ushuaia as a naval base and tourist resort and to make use of the natural resources of the region. Aside from their work for the Ministry of Marine, the aim of the colonists is to develop cellulose and other wood-products industries based on the surrounding forests.

PERSONNEL AND TERMS OF AGREEMENT

Selection of participants had been rigidly controlled, and the group represented virtually all the trades and professions necessary for the functioning of a small modern settlement—chemical engineers, masons, mechanics, plumbers, electricians, a priest, a baker, a doctor, and so on. Seventy-two of the men had brought their families. These comprised 18 children under two years of age, 14 between three and five years, and 29 between 6 and 14 years, and also 14 older children.[1] With the exception of four unmarried women, the remainder of the group consisted of single men or men with families still in Italy.

When signing, the colonists agreed to remain for two years; those wish-

[1] *Crítica*, Buenos Aires, Nov. 10, 1948.

➤ MR. HITCHCOCK is Assistant Director of the Society and head of its Department of Hispanic American Research.

ing to stay afterward will be eligible for additional subsidy from the Argentine government. During the two-year period they are to work eight hours a day, at a rate of three pesos (about 60 cents) an hour, for a 200-hour month in spring, summer, and fall and a 100-hour month in winter.

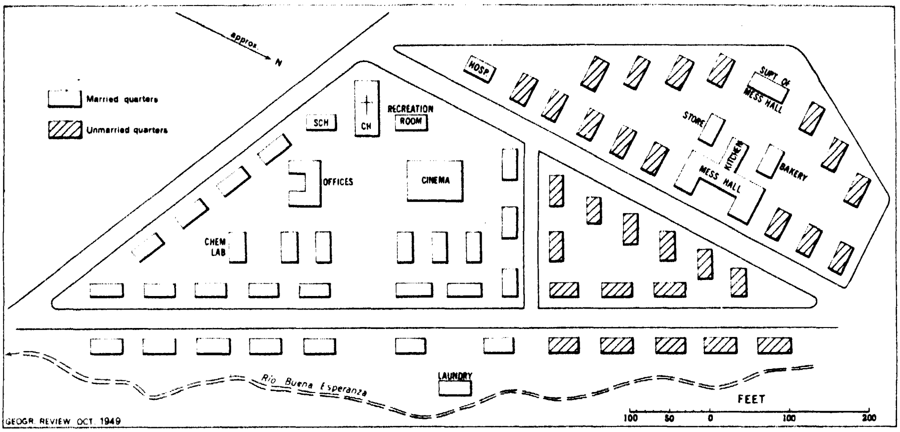


FIG. 2—Plan of Empresa Borsari.

Among the official projects specified in the contract were the completion of a 200-room government hotel near Cerro Olivia, the foundations of which had already been laid by the Argentines,[2] construction of a hydroelectric plant on the Río Olivia, improvement of naval dock facilities, and construction of other government buildings, such as officers' houses and a school. In addition, the colonists were to build their own houses and workshops.

The site for the settlement, chosen by the Argentine government, lies slightly to the west of the existing town (Fig. 3) on gently rolling land traversed by a small stream of clear water, the Río Buena Esperanza, the source of which is in the main glaciated Andean chain rising abruptly to the north of the port. Plans for the village had been carefully worked out before the arrival of the Italians, gravel-surfaced roads had been constructed, and small Andean beeches (*coihué*) planted along them (Fig. 4). Seventy-two prefabricated houses—surplus war materials—were purchased in Italy with Argentine funds and brought directly from Genoa. Equipment for a complete chemical laboratory, a hospital, a brickmaking plant, and a factory for cellulose products was also brought.

[2] J. E. Church: In Argentine Tierra del Fuego: Notes on a Tour, *Geogr. Rev.*, Vol. 38, 1948, pp. 392–413; photograph on p. 406.

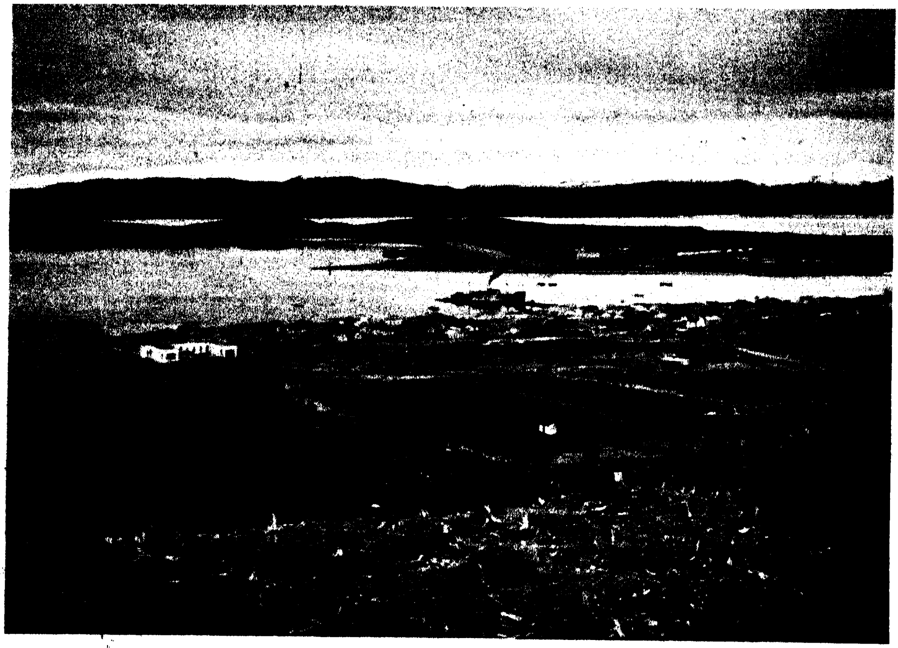
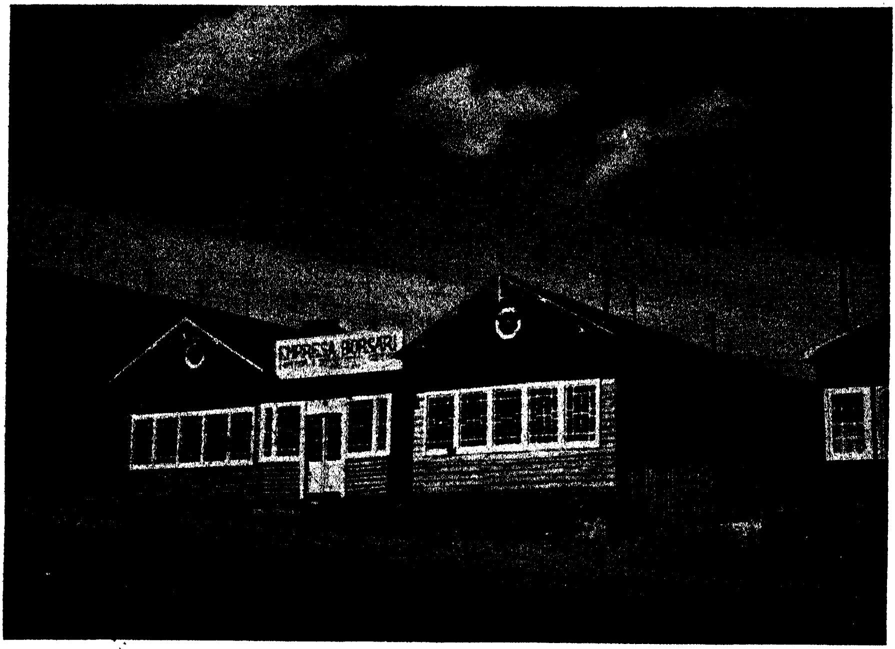


FIG. 3—Ushuaia and the Beagle Channel, looking south. Penitentiary at extreme left; Argentine transport *Chaco* at dock; air strip in middle distance across harbor.

FIG. 4—Preliminary tree planting and street layout, Empresa Borsari.

FIG. 5—Colonists laying the foundations for the first houses. The site of the settlement lies just to the right of the town as shown in Figure 3.

FIG. 6—Filling in the foundations with boulders from the bed of the Río Buena Esperanza.



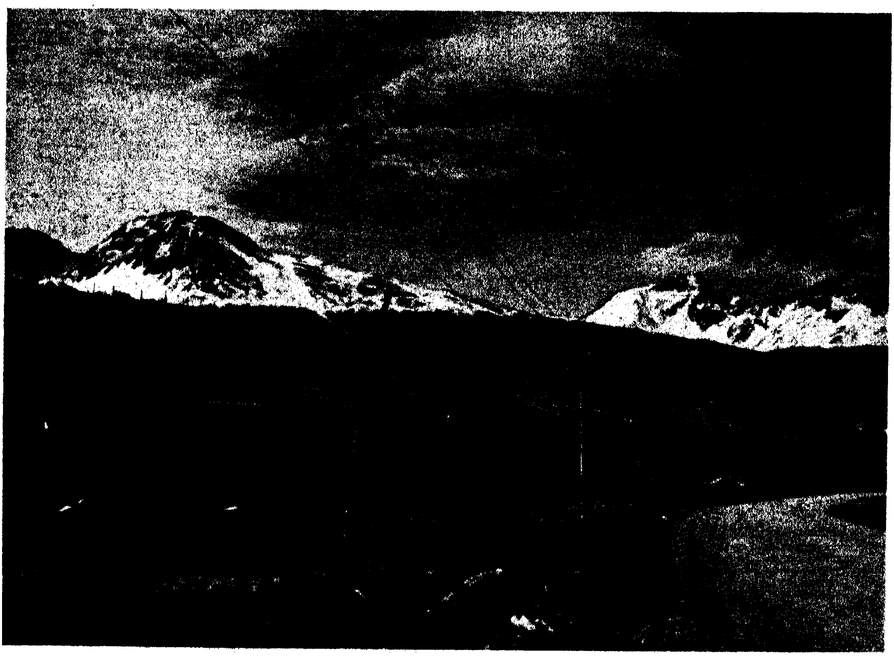


FIG. 7—Combined dormitory and dining hall.

FIG. 8—Argentine sergeants' and corporals' quarters built before the arrival of the colonists. Additional quarters of this type have since been constructed by the Italians.

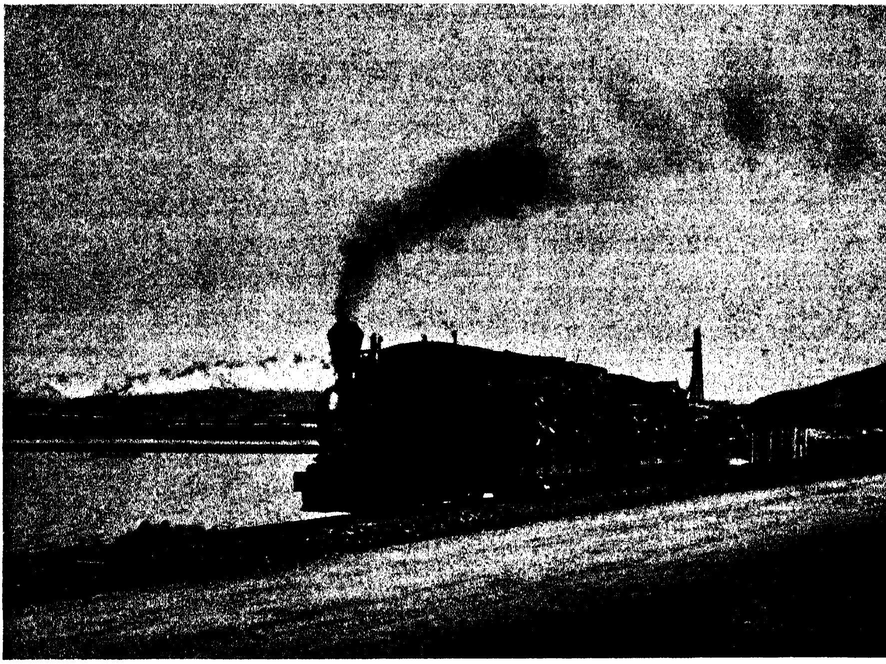


FIG. 9—*El Primer Fuegino*, the logging railroad.

FIG. 10—The terminus of the railroad, showing logging operations and cut-over lands along the right of way.

Beginnings of the Settlement

At the time of the writer's visit, on November 13, seven days after work had begun, the village was a scene of great activity. House sites were being surveyed and staked out, and foundation walls for five houses had been completed within three days. Wooden forms were being constructed for walls, and cement, supplied by the Argentine Navy, was being poured into the forms (Fig. 5). There were no cellars; the interior ground was merely covered with a fill of waterworn boulders and cobbles from the near-by stream (Fig. 6). Plans call for eventually tapping the waters of the stream for individual houses and for a small hydroelectric plant. Most of the workers were uniformly clad in pinkish khaki outfits, brought with them from Europe, and a general air of cheerfulness and industry prevailed.

During construction of the houses, many of the group, especially families with children, were sheltered in wooden government buildings at the east end of town near the old penitentiary (Fig. 7); the rest were quartered on the Argentine transport *Chaco*, at the end of the town dock. At noon, work halted for lunch, and the workers walked into town to the dining hall. Five jeeps and two 3-ton trucks were at the disposal of the colonists but were hardly sufficient to take care of their transportation needs.

For entertainment, the plans call for a motion-picture house, a recreation room (the group includes both orchestral and choral talent), and a library of some six thousand books. A sports field is planned for football games, the equipment for which was also brought from Italy.

Recent Progress

The work has been going forward satisfactorily since last November. In a letter dated February 24, 1949, Dr. Sergio Baldini, a chemist member of the settlement, writes:

> Our village has made much progress, and now we are living in one of its little houses. The houses for the single technicians and clerks have four bedrooms, a living room, and a bathroom with water heater. Two of us live in each bedroom. The family houses have a kitchen, a bedroom, a living room, and a bathroom. Up to now 60 buildings have been erected; in the next few days the mess hall, the church, and the hospital, which is now in a barrack in Ushuaia, will be erected. Each house has water taken directly from the near-by river. Now it will be necessary to set up the light. I fear that it will not be so easy, because of failure of the electrical material.
>
> The other works are progressing, too. We are now building a school in the center of Ushuaia on the street bordering the bay. We are making the foundations. There is some difficulty in doing this because of water seepage from the bay. The Argentine Marine officers' houses are progressing, too. We have built three of these and are now making

houses for sergeants and corporals [Fig. 8]. On the Olivia River the electric plant is about finished and will have a power of about 500 horsepower. The tourist hotel is not progressing because of lack of the necessary materials for its completion. The freezing plant on the third street in Ushuaia is about finished, and I think that it can be used before the winter. My work is still in the beginning stages. I am now making some experiments for baking clay to be used in brickmaking. I think it will be possible within a few days to make bricks in great quantity. We must build up the manufacturing of cellulose as soon as possible, and the making of pressed wood, and also construct the brick oven. This is all the news in Ushuaia.

In a more recent letter (June 5, 1949), Dr. Baldini notes further progress:

Now we are undertaking a new project. At the end of August the families of our workers and clerks will arrive, and so we are now building up a new village on the other side of the Buena Esperanza River. The new village is completely made of brick and consists of 43 houses. There are three sorts of them; for families with one child, with two children, or with more. All the houses are of one floor only.

All the works for the Argentine Marine have been suspended now, except for a few—the officers' houses, for instance—in order to allow us to finish this last important work as soon as possible. Now all our efforts are concentrated in doing this, struggling hard against the winter, the lack of material, and the great difficulties of the ground, which is all water-soaked and frozen turf. In spite of it, we hope we can dispose of everything before August is over, so that the families can find houses and all they need.

The Future

The writer left Ushuaia wondering how this mass transplantation and the plans for industrial development would fare. Much of the surrounding virgin forest has long since been destroyed by fire and cutting. A small lumbering railroad, *El Primer Fuegino* (Fig. 9), runs west from the town past the Italian settlement to a terminus some nine miles inland (Fig. 10). Wood, mainly *coihué* and *roble* (oak), is cut and transported to Ushuaia for heating the buildings of the naval personnel. The Italians are to be supplied with wood for fuel after the Argentine needs are met. In looking to the future, reforestation is a matter deserving immediate government attention, particularly in view of the plans for development of forest industries.

The region is one of great scenic beauty, but it offers climatic difficulties. The growing season is short, and latitudinal problems of daylight are similar to those of Sitka and Churchill in the Northern Hemisphere. Soils are excessively stony, though gardens in the town evidence the successful growth of selected crops. Mineral resources of the Fuegian Andes still await development.

The isolation of the community, previously accessible with relative ease only by boat, has been alleviated by the inauguration of scheduled com-

mercial air service in 1948. Also, a road linking Ushuaia with northern Tierra del Fuego was under construction at the time of the writer's visit. Neither of these developments, however, alters the fundamental fact that the inhabitants are still mainly dependent on food—even fish—brought in at great expense from the north, and it is difficult to maintain a balanced and permanent settlement that is based largely on subsidy and imported foodstuffs.

FIG. 11—Empresa Borsari as it looked in April, 1949. By June, 72 houses had been completed. (Photograph from Dr. Sergio Baldini.)

THE STRANGE FARMERS OF THE GAMBIA

H. REGINALD JARRETT

WHO are these oddly named "strange farmers" of the Gambia? According to the official designation they are seasonal immigrants from neighboring French or Portuguese territory, or even within the Gambia itself.

The name is curious since it conjures up visions of eccentric agriculturalists or exotic forms of agriculture, but it has received official recognition in more than one local ordinance. In Mandinka the strange farmer is "Sama manila," literally "rains (or summer) abroad," a much more descriptive title.

Just when this immigration of seasonal labor began is uncertain. J. H. Palmer, author of the above quotation,[1] says it has been going on for 90 years, and probably much longer. "Before the groundnut crop became important there were most likely immigrants who came for petty trading and who probably worked for the means wherewith to purchase their 'stock in trade.' " By 1852, Governor MacDonnell was reporting that "at least one third of the produce exported" was groundnuts grown by strange farmers who came from the interior and stayed for two or three years. During the last several decades the relation between the strange farmer and the groundnut crop has been clear enough (see Table I). The Gambia is comparatively sparsely populated. In 1946 the total population of the Protectorate[2] was only 228,114, or 56.9 to the square mile, and this is a substantial increase over prewar figures.[3] On the other hand, there has been, and still is, an economic urge to grow groundnuts, a crop to which the light, lateritic soils covering much of the Protectorate are eminently well suited.[4] During the years 1930–1934 the Gambia ranked sixth among the groundnut-exporting countries of the world, contributing 3.62 per cent of the total.

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[1] J. H. Palmer: Notes on Strange Farmers, *Sessional Paper No. 15, 1946,* Bathurst, 1946, p. 1.

[2] For the administrative divisions of the Gambia see the map and caption in H. R. Jarrett: Population and Settlement in the Gambia, *Geogr. Rev.*, Vol. 38, 1948, pp. 633–636. According to the Colonial Office List 1949: "The Colony consists of the island of St. Mary and British Kombo. It also comprised Albreda, the Ceded Mile, the territories of Brefet and Bajana, and MacCarthy Island . . . until 1946 when these lands were vested by order under the Protectorate Lands Ordinance, 1945, in the Native Authorities." The area of the Protectorate is 3964 square miles; of the Colony, 69 square miles.

[3] Colonial Office Annual Report on the Gambia for the Year 1946, *Colonial Ann. Repts.*, London, 1948, p. 7. In 1947 the population of the Protectorate was 225,358 (*ibid.*, for 1947, London, 1949, p. 5).

[4] On the requirements for groundnuts see, for example, K. H. W. Klages: Ecological Crop Geography, New York, 1942, p. 426.

➤ MR. JARRETT, lecturer in charge of geography at the County Technical College, Guildford, Surrey, was senior geography master at the Methodist Boys' High School, Bathurst, from 1941 to 1944.

TRADE IN GROUNDNUTS

Figure 1 shows the march of the groundnut export trade of the Gambia. The first record of export was in 1830, when 100 baskets of nuts, priced at $0.50 a basket, were shipped. The new export grew steadily—in 1834, 213 baskets; in 1835, 47 tons. With some fluctuations, increase continued until

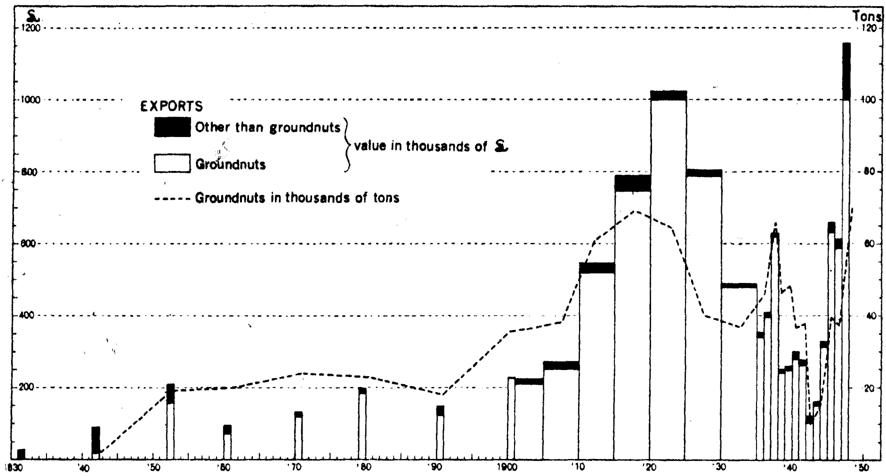

FIG. 1—Value and tonnage of exports of the Gambia, 1830–1948.

1915, when a maximum shipment of 96,000 tons, valued at £400,000, was made. Since that time shipments have fluctuated considerably, both in volume and in price. The 1948 crop, reported to be about 70,500 tons, is the best since 1934.

Table I gives the groundnut export by volume and the number of strange farmers for every year since 1912. It has generally been assumed that the export from the Gambia has been produced one-third by native farmers, one-third by strange farmers, and one-third in adjacent French territory.[5] Table II, covering the prewar years since 1934, shows how the strange farmers distributed themselves; Table III gives their origins in 1945. It would seem that the strange farmer of Gambian origin is an important element, deserving more attention than he has hitherto received.

Two points emerging from Table I call for comment. Since all or nearly all the crop grown and lifted in any particular season is exported in the early months of the following year, in the so-called "trading season," one might expect a correlation between the number of strange farmers in any particular

[5] Report of the [Colonial Office] Mission Appointed to Enquire into the Production and Transport of Vegetable Oils and Oil Seeds Produced in the West African Colonies, *Colonial No. 211*, 1947, p. 22.

TABLE I—STRANGE FARMERS AND EXPORT OF GROUNDNUTS*

YEAR	STRANGE FARMERS	GROUNDNUTS (*Tons*)	YEAR	STRANGE FARMERS	GROUNDNUTS (*Tons*)
1912	6,525	64,196	1931	9,736	66,811
1913	9,940	67,404	1932	16,513	37,315
1914	14,908	66,885	1933	14,537	67,370
1915	32,220	96,151	1934	8,332	71,919
1916	9,315	46,366	1935	13,341	44,712
1917	20,727	74,300	1936	9,754	49,104
1918	20,509	56,490	1937	13,479	66,566
1919	22,440	70,290	1938	9,195	46,651
1920	24,150	84,037	1939	4,643	48,925
1921	22,048	58,273	1940	4,890	39,188
1922	20,566	62,978	1941	3,741	40,318
1923	17,383	62,564	1942	2,585	15,651
1924	14,188	58,980	1943	5,995	17,756
1925	14,652	46,583	1944	10,793	27,538
1926	13,555	57,344	1945	19,979	41,094
1927	17,237	65,107	1946	13,263	37,772
1928	20,640	74,442	1947	14,662	54,245
1929	18,874	56,355	1948		70,500 (approx.)
1930	16,592	74,761			

*Compiled from the following sources: Palmer, *op. cit.*, p. 9; Annual Report on the Gambia, for the Year 1946, pp. 7 and 15; *ibid.*, for 1947, p. 15; and *Crown Colonist*, Vol. 19, 1949, p. 205.

TABLE II—DISTRIBUTION OF STRANGE FARMERS IN THE GAMBIA*

	NORTH BANK		SOUTH BANK		MACCARTHY ISLAND		UPPER RIVER
YEAR	Gambians	Others	Gambians	Others	Gambians	Others	Gambians & Others
1934	813	1,056					
1935	1,004	1,205	1,695	1,644	788	2,390	4,615
1936	787	869	1,487	1,332	683	1,749	2,847
1937	984	1,530	1,578	2,033	846	2,844	3,764
1938	599	1,210	1,524	1,680	724	1,348	2,074
1939	468	491	708	946	253	960	817

*R. R. Kuczynski: Demographic Survey of the British Colonial Empire, Vol. 1, West Africa, London, etc., 1948, p. 335; Palmer, *op. cit.*, p. 9.

TABLE III—STRANGE FARMERS AND THEIR FOLLOWERS IN 1945*

PROVINCE	Gambian	French	Portuguese	Total
Upper River	917	3,982	92	4,991
MacCarthy Island	1,290	6,296	290	7,876
North Bank	737	2,344	137	3,218
South Bank	722	2,138	434	3,294
Kombo North & St. Mary	176	321	103	600
Total	3,842	15,081	1,056	19,979

*Kuczynski, *op. cit.*, p. 776.

year and the volume of groundnut export in the following year, with allowance for fluctuations in the harvest consequent on fluctuations in the rains. No such correlation is apparent. For instance, the table shows 13,341 strange farmers in the 1935 season and an export of 49,104 tons of groundnuts in 1936; 9754 strange farmers in 1936 and an export of 66,566 tons in 1937; 13,479 strange farmers in 1937 and an export of 46,651 tons in 1938.

The second point is the remarkable fluctuation in the number of strange farmers from year to year—a fluctuation so great and so haphazard as to make any average figure of doubtful value. It is difficult, if not impossible, to account for this satisfactorily, though in a general way one or two factors stand out. The high numbers recorded for the years 1917–1922 have an obvious connection with the high prices obtaining during and immediately after the First World War, and the effect of the Second World War is seen in the low numbers that came in from 1940[6] through 1943. The military breach between the British Gambia and Vichy French Senegal had, of course, important economic consequences; for political and security reasons seasonal immigration from Senegal of the type we are considering was discouraged by the doubling of the legal tax the strange farmer had to pay. The tax is normally 8*s*., collected by the landlord, but from 1941 until 1943 it was raised to 16*s*. This applied also to Gambian strange farmers, in order to encourage young men to stay at home and help increase the production of food crops in their own districts. In 1943 the tax on foreign strange farmers was reduced to 8*s*. everywhere except in Kombo St. Mary, and in 1946 the reduction was made applicable to all strange farmers everywhere. In the past the tax was payable to the government, but since January, 1946, as a result of the passing of the Protectorate Treasuries Ordinance, the money has gone into the exchequers of the local native authorities.

Reasons for the Migration

Little correlation is apparent between the number of strange farmers and the price payable to the farmer for groundnuts (Table IV). Clearly, therefore, it is a matter of some difficulty to account fully for the strange-farmer phenomenon. Palmer has come to the conclusion that psychological factors, such as a natural youthful desire to break away from family ties and routine work and a longing to see other places and mix with strangers, play no small part. He finally argues, however, that "the main reason at the present day

[6] There were even fewer in 1939 than in 1940, but this can hardly be attributed to direct wartime causes.

TABLE IV—PRICES OF GROUNDNUTS AND NUMBERS OF STRANGE FARMERS*

YEAR	AVERAGE PRICE PER TON £ s. d.	PRICE TO FARMERS TON £ s. d.	STRANGE FARMERS
1920	27 12 0	No record	24,150
1921	10 12 0	No record	22,048
1922	12 3 0	No record	20,566
1923	13 12 0	9 0 0	17,383
1924	14 5 0	10 0 0	14,188
1925	14 3 0	9 10 0	14,652
1926	14 5 0	9 0 0	13,555
1927	14 1 0	No record	17,237
1928	14 13 0	No record	20,640
1929	13 11 0	7 10 0	18,874
1930	11 12 0	4 17 6 to 8 0 0	16,592
1931	7 11 0	3 10 0	9,736
1932	10 9 0	5 0 0	16,513
1933	7 8 0	4 0 0	14,537
1934	5 7 0	3 10 0	8,332
1935	8 3 0	7 0 0	13,341
1936	8 12 0	6 6 8	9,754
1937	9 14 0	3 13 4	13,479
1938	5 14 0	3 3 4	9,195
1939	5 1 0	4 10 0	4,643
1940	6 7 0	4 0 0	4,890
1941	5 19 0	4 0 0	3,741
1942	5 19 0	5 10 0	2,585
1943	7 13 0	8 0 0	5,995
1944	10 6 0	12 0 0	10,793
1945	14 9 0	12 0 0	19,979

*Compiled from Palmer, *op. cit.*, p. 9; and *Colonial No. 211* (*op. cit.*), p. 59 (App. 4).

for this influx [of strange farmers] is the desire of the African to obtain cash or goods to set himself up in life." A young man who stays at home is often compelled by circumstances to work on his father's or family's farm, with little remuneration. A "summer abroad" means hard work, but it does provide cash that he would be unable to earn at home, with which he can redeem a debt or provide a dowry for a wife. It also presents an opportunity for buying English-made cloth.

The West African woman is very "dressy". . . . For many years Manchester has carefully studied and met the exact requirements of the trade in cotton goods, and the brightly coloured cottons which that city provides appeal to the native taste in a way in which neither American nor French made cottons ever do. The usual practice is for strange farmers to convert much of the cash received for their groundnuts into cloth. So extensive are their purchases that certain limitations had to be imposed on the sale of the cloth during the war years on account of shortage of supply.[7]

[7] Palmer, *op. cit.*, p. 2.

A further point with some bearing on this matter is an economic one. The prices that can be got for groundnuts in the Gambia, with its readily accessible ports, are considerably higher than they would be inland, especially in the remoter areas, because of the high cost of transport between the interior and the coast. Costs of transport in the Gambia are low, because distances from the river ports are never great. "It is, in short, cheaper for the farmer to move himself than to pay for the transport of his produce from the more remote hinterland."[8]

S. H. Frankel[9] has emphasized the importance of cheap transport in the economic development of Africa. A system of human porterage ravages the economic power of a local population. It has been calculated that the transport of 100 tons of produce a month over a distance of 100 miles would require 2000 men—a requirement utterly beyond the power of a sparsely populated area such as Senegambia. An average railroad train is said to do the work of 15,000–20,000 carriers for one-fifth to one-tenth of the cost, but most of Senegambia, even today, is not served by a railroad. In northern Nigeria groundnuts that had been sold by the growers for £3 10*s.* 0*d.* a ton fetched £40–£45 after the railroad reached Kano.[10] The economic urge that brings the Senegalese strange farmers to the Gambia is thus heavily underlined.

Working Agreements

The strange farmers begin to arrive in the Gambia in March, and until the end of June there is a steady influx. As a Gambian chief put it, "A good strange farmer comes when the 'netto' [locust bean] is in flower [March and April] and helps his landlord to clear his grain farms."[11] When they have sold their crop, which has normally been done by the end of December, the strange farmers return to their homes.

After the strange farmer has arrived in the locality of his choice, he bargains with his prospective landlord until they reach an agreement. The agreement is verbal, and terms vary from place to place. They are always kept, except that the strange farmers seem to have resented the payment of *lajino*—a commission landlords were in the habit of levying on the cash the immigrants received for their groundnuts (usually 2*s.* in the pound). Gener-

[8] Annual Report on the Gambia for the Year 1947, p. 16.

[9] Capital Investment in Africa, issued under the auspices of the Royal Institute of International Affairs, 1938, p. 32.

[10] Lilian C. Knowles: The Industrial and Commercial Revolutions in Great Britain during the Nineteenth Century (London School of Economics and Political Science Monograph No. 61), London. 1921, pp. 143–144.

[11] Quoted by Palmer, *op. cit.*, p. 2.

ally the landlord provides board, lodging, and a groundnut farm. If there is no spare hut in the landlord's compound, the strange farmer may build one himself, sometimes with the landlord's help. He shares the food of the landlord and his family, eating from the communal bowl. If his own farm is some distance away, the landlord's wife will provide him with his midday meal in a calabash, and in return for this service he will often supply the firewood for cooking (this is sometimes specified in the original agreement, but not always). Sometimes, in addition, the landlord will advance a hoe, to be paid for later from the sale of the groundnuts, and sometimes a mosquito net on the same terms. Incidentally, a good strange farmer is said to wear out three hoes in a season, perhaps because, before the war, a soft iron, preferred by Gambian smiths for its malleability, was imported for manufacture into hoes.

In return the strange farmer undertakes to work for the landlord a certain number of days a week—usually two or three. In Niani District, MacCarthy Island Division, four days are required, but this is exceptional. At a recent Chiefs' Conference[12] the possibility of requiring strange farmers either to work extra days on the landlords' food farms or to make food farms for themselves was considered. Although such an arrangement would augment the food resources of the country, it might have the effect of discouraging immigration, and it is not likely to become compulsory even if it is encouraged as a voluntary agreement. Even at present, before the strange farmer is free to begin his own work, he must help in preparing the land and planting the early grains—chiefly maize and millets—on the landlord's farm. Until very recently there was always a "hungry season" at the end of the dry season, lasting until the harvesting of the earliest grains toward the end of August. Since the strange farmer shares his landlord's food, it is obviously to his advantage, as well as to his landlord's, that he tend the early grains well.

Asset or Liability?

From time to time the question has been raised whether the strange farmer is not, on the whole, a liability to the Gambia rather than an asset. The Gambian farmer and the trading firms have no doubts on the matter. The farmer likes the immigrant, and relies on him, and views with concern any attempt by government or by local native authorities to control the yearly influx; the trading firms have frequently pressed for the abolition of the tax demanded from the strange farmer, in order to encourage him and thereby increase the quantity of groundnuts available for export. Native

[12] "Summary of Proceedings of the Second Conference of Protectorate Chiefs Held at Brikama, 1945," Bathurst, 1945, pp. 12–14.

authorities have at times urged this measure too. "Our rice farms are good, but we have insufficient labour. If strange farmers came in tax free they would help us in growing rice" was the verdict of Seyfu Musa Cham of Nianija at the Chiefs' Conference in 1945. Said Seyfu Matarr Sise of Upper Saloum: "We have large swamps unused and need strangers to cultivate them. Strange farmers should come in tax free and subject only to labour to the landlords who feed them." And Seyfu Momodu M'Baki of Sami remarked: "Strange farmers should be encouraged to come in tax-free if they farm rice and not groundnuts."

On the liabilities side, however, must be set the fact that the strange farmer necessarily consumes a certain amount of food during his stay—and until very recently the Gambia has had to import food. It has already been noted that at the Chiefs' Conference it was debated whether it would be practicable to compel the strange farmer to grow food for himself as well as groundnuts. Though the chiefs were not in favor of such compulsion, two informal suggestions were made: that the strange farmer should work three days a week for the landlord, three days on his own groundnut farm, and one day on his own food farm; that he be required to work an extra day a week on the landlord's food farm. These schemes were to be tried out in 1946.

Palmer computes that, on the basis of a daily consumption of one pound of grain,[13] each strange farmer in the Gambia will consume 182 pounds during a stay of six months and that therefore 12.3 strange farmers will consume a ton of grain during a single season. On this basis, the 19,979 strange farmers in 1945 must have consumed something like 1595 tons of grain. In this same year 1111 tons of grain was imported into the Gambia. Palmer also computes that, at an admittedly low average cost of living of *2d.* a day (rice at *3d.* a pound, millet 1½*d.*), the value of the grain consumed by the strange farmers in 1945 amounted to £29,773, whereas the value of the grain imported in that year was £46,662. It can be argued, then, that in 1945 the strange farmer was financially a liability rather than as asset.[14]

Against this view should be balanced that expressed by Seyfu Kande Kasse Jawara of Wali at the Chiefs' Conference, who argued: "Strange farmers have not made us short of food. It is the failure of the rains that has

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[13] "The Nutrition Officer considers that 1 lb. of grain, augmented by cassava, groundnut oil, fruit, etc., is sufficient to keep up the necessary calories" (Palmer, *op. cit.*, p. 7).

[14] Palmer's computations are open to some criticism, because he does not allow for the substantial number of strange farmers of Gambian origin, who would have to be fed anyway. It seems unlikely, however, that the omission invalidates his general thesis. In 1945, for example, the 3842 strange farmers of Gambian origin would have consumed, at the rate assumed, 310 tons of grain, which is hardly enough to change the picture as Palmer presents it.

TABLE V—GRAIN CONSUMPTION BY STRANGE FARMERS*

YEAR	STRANGE FARMERS (*Average Number*)	GRAIN CONSUMED *Tons*	VALUE £	GRAIN IMPORTED *Tons*	VALUE £
1915–1919	21,042	1,711	32,000	2,000	58,000
1920–1924	19,667	1,599	29,000	2,500	129,000
1925–1929	16,991	1,380	25,000	2,300	105,000
1930–1934	13,142	1,069	20,000	5,150	50,000
1935–1939	10,082	819	15,000	6,000	50,000
1940–1944	5,601	455	8,000	1,250	24,000
1940	4,890	398	7,429	2,313	33,795
1941	3,741	304	5,674	1,199	22,281
1942	2,585	210	3,920	32	48,768
1943	5,995	486	9,072	988	45,519
1944	10,793	869	16,238	3,036	68,420
1945	19,979	1,595	30,296	1,111	46,662

*From Palmer, *op. cit.*, p. 7.

caused that. If we have more strange farmers I can get more food if the rains are good, for we have made a rule that all strange farmers must plant local foodstuffs."

It would seem from Table V that until 1944, except for the year 1942, when imports were forcibly and painfully cut because of the exigencies of war, imports of grain would have been necessary even had there been no strange farmers to feed; that in 1945 it was the strange farmers' consumption that made imports of grain necessary; and that by 1946 an overall self-sufficiency had been reached. This may have been a direct result of the implementing of the chiefs' suggestions referred to above. On the basis of the latest figures, therefore, it is hardly justifiable to regard the strange farmer as a liability rather than an asset.

It seems as though the function of the strange farmer had been undergoing a distinct change during these present years, and that, although it may continue to be true that the growing of groundnuts will be in the future, as in the past, his primary concern, he will probably also be concerned with the growing of food, especially grains, to an increasing degree.

GEOGRAPHIC REGIONS IN KOREA

SHANNON McCUNE

GEOGRAPHIC diversity is a reality in Korea. The different parts of the peninsula have different physical characters;[1] the successive waves of settlement and subsequent local developments resulted in the diverse human geography. Throughout much of Korea's history the central government was weak, and the eight political divisions, usually called *do* or "provinces," had considerable local autonomy.[2] In the three decades before 1945 the Japanese modified some of the regionalism in Korea, by building railroad lines and highways and by creating a strong government with centralized political and economic control.[3] The 38th parallel, demarcating the American and Soviet occupation zones, imposes a new kind of boundary. This arbitrary line cuts across the grain of the country and thus across administration lines, which, developed over a long period of history, usually followed natural features.[4] However, in a broad way, there are marked differences between north and south, between the Soviet-backed democratic Republic of Korea and the United Nations-approved and United States-recognized Republic of Korea.

The geographic regional divisions of Korea have been treated at some length by Japanese geographers and others.[5] Two recent European regional studies merit attention.

In his book "Korea" V. T. Zaichikov stresses that variety is the keynote of Korean geography.[6] He attributes this circumstance in part to Korea's transitional position between the continent of Asia and insular Japan. He notes the contrast between the west side of the peninsula, facing the Yellow Sea, and the east side, facing the Japan Sea. The northwest, according to Zaichikov, has been exposed to a profound Chinese influence; the southeast has felt the impact of the Japanese. The mountains, which occupy two-thirds of the area, have in recent times become of importance for their forest, hydroelectric, and mineral resources. The densely populated plains are the granaries; on them are grown three-fourths

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[1] See Shannon McCune: Climatic Regions of Korea and Their Economy, *Geogr. Rev.*, Vol. 31, 1941, pp. 95–99; and Arthur H. Robinson and Shannon McCune: Notes on a Physiographic Diagram of Tyosen (Korea), *ibid.*, pp. 653–658.

[2] A brief account of the provinces and their boundaries is given in my article "Physical Basis for Korean Boundaries," *Far Eastern Quart.*, Vol. 5, 1945–1946, pp. 272–288. Descriptions of the eight provinces close to the time when Korea was opened to the Western world can be found in W. E. Griffis: Corea, The Hermit Nation, New York, 1882, Chap. 23.

[3] See, for example, A. J. Grajdanzev: Modern Korea, New York, 1944.

[4] The 38th parallel is described in "Physical Basis for Korean Boundaries" (*op. cit.*), and its implications are discussed in my article "The Thirty-Eighth Parallel in Korea," *World Politics*, Vol. 1, 1948–1949, pp. 223–232.

[5] Lautensach in his "Korea" (see footnote 7, below) has an extensive bibliography of Japanese works and other writings, altogether some 936 selected references. Two useful Japanese geographic encyclopedias have volumes on Korea: "Nihon Chiri Taikei," Tokyo, 1930, Vol. 12, and "Nihon Chiri Fuzoku Taikei," Tokyo, 1931, Volumes 16 and 17.

[6] V. T. Zaichikov: Korea. 228 pp.; maps, ills., bibliogr., index (of geographical names). State Publishing House of Geographic Literature, Moscow, 1947. The discussion of the regions and the map are on pp. 121–124. I am indebted to Dr. Albert Parry of Colgate University for aid in the translation of parts of this book; a complete translation is in progress.

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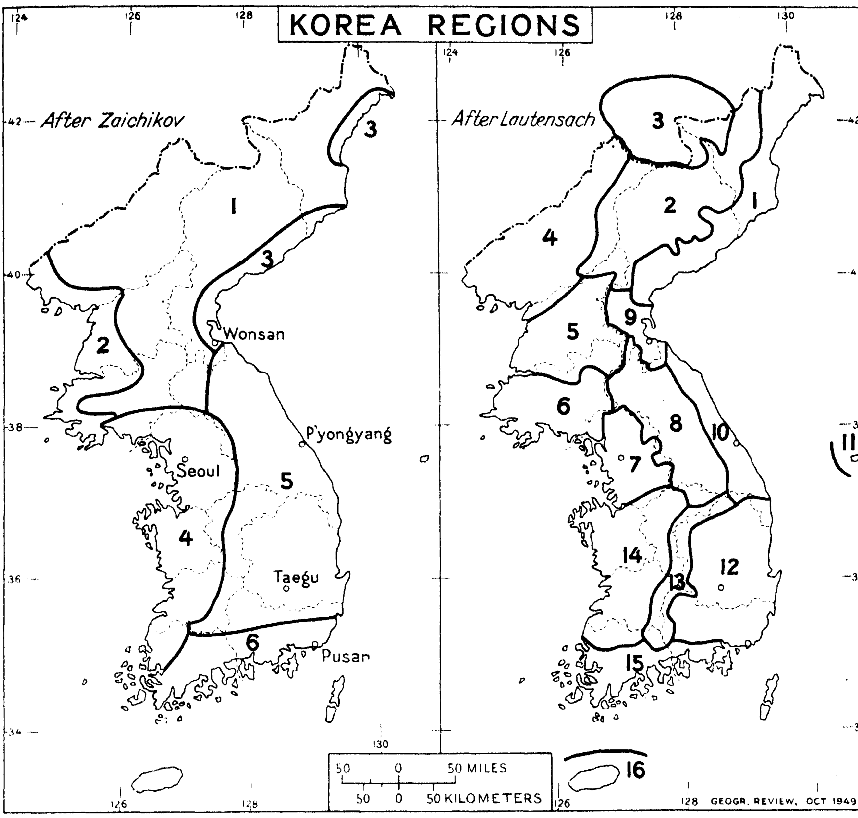

FIG. 1—Geographic regions of Korea according to Zaichikov. Key: 1, North Korean Mountains; 2, Northwestern Coast; 3, Northeastern Coast; 4, Western Plains; 5, East Korean Mountains; 6, Southern Coast and Islands.

FIG. 2—Geographic regions of Korea according to Lautensach. The regions as translated from the German and modified to fit Korean language place names are as follows: (North Korea) 1, Japan Sea Borderland; 2, Northern Interior Highlands; 3, Paektu San Area; 4, North P'yongan Region; (Central Korea) 5, Taedong Basin; 6, Hwanghae Peninsula, 7, Kyonggi Region; 8, Upper Han River Region; 9, Wonsan Area; 10, Taepaek Chain; 11, Ullung Island; (South Korea) 12, Naktong Basin; 13, South Korean Diagonal Chain; 14, Ch'ungch'ong-Cholla Region; 15, Southern Coast Borderland; 16, Cheju (Quelpart Island).

of the rice and five-sixths of the barley and cotton. The bases for trade and fishing and the manufacturing centers are located in the maritime zones. Zaichikov believes that the political units (often used by Japanese and others) are too heterogeneous to be grouped into geographic regions. He criticizes Lautensach's divisions (discussed below) as furnishing too diverse a pattern, somewhat like a crazy quilt. Instead, Zaichikov divides Korea into six basic regions "by taking into consideration the most significant differences in natural conditions, economic specialization, and singularities of historical development." The regions (see Fig. 1) are North Korean Mountains, Northwestern Coast, Northeastern Coast, Western Plains, East Korean Mountains, and Southern Coast and Islands. In his discussion he notes the existence of transitional zones and described certain subdivisions.

Herman Lautensach's "Korea" is the culmination of an extensive study of Korean geography through field work and perusal of the literature, and it is a definitive work.[7] Three-eighths of the text is devoted to the geographic landscape, in which he presents a well-organized, though slightly complex, regional pattern. Following Braun and Hartnack,[8] he takes into consideration both the "total" and the "central" characteristic stamps on the landscapes. The "total" impresses are always present in the land areas and give them comparable characteristics. The "central" impresses are derived from points—sometimes large cities or features such as river valleys or highways—and they may be near the boundary of an area. They give it the individuality and diversity that set it off from surrounding areas. Lautensach considers that, in part because of the peninsularity and the physical character of Korea, the primary dividing lines trend east and west, forming three large groups of areas: the North, the Center, and the South. The boundary between North and Central Korea runs between the two gulfs, roughly between 39½° N. and 40° N. This marks the northern limit of winter-wheat cultivation. The boundary between Central and South Korea follows closely the 37th parallel. This marks the northern limit of cultivation of American-type cotton and of paddy-field cultivation of winter wheat. To the north are oats and corn and other species of wet rice. Lautensach's secondary division lines take account of the difference between the Yellow Sea, the interior, and the Japan Sea segments of the peninsula. Sixteen landscape areas are delimited (see Fig. 2).

Study of the diversity revealed by these geographic regional patterns emphasizes the fact that the present barrier of the 38th parallel is destructive of the healthy interchange that has existed. The longer this boundary persists, the more the divisions will grow apart, creating an ever-widening wedge in what has been a unified land.

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[7] Hermann Lautensach: Korea: Eine Landeskunde auf Grund eigener Reisen und der Literatur. xv and 542 pp.; maps, diagrs., ills., bibliogr., indexes. (Geographische Handbücher.) K. F. Koehler Verlag, Leipzig, 1945. To judge by the foreword, the manuscript was completed in November, 1942. The four colored maps, on the scale of 1 :2,000,000, show topography by hypsometric tints, mean annual rainfall (15 tints), population distribution (one dot to 1000 persons), and "cultural geography," including forests and dry and wet cultivation. The illustrative material is as comprehensive as the text; it includes 82 photographs of landscapes, land-utilization types, and people, reproductions of typical parts of the 1 :50,000 topographic map, town plans and distribution maps, and diagrams covering every phase of the geography of the country. The regional map is Plate 23, facing p. 192.

[8] G. Braun and W. Hartnack: Die preussische Provinz Pommern bei der Neueinteilung Deutschlands, *49/50. Jahrbuch Pommerschen Geogr. Gesell., Greifswald (1931/32)*, 1932, pp. 53–88.

THE AMERICAN GEOGRAPHICAL SOCIETY

The Society's Glacier-Study Program

A project for the more comprehensive study of glaciers and ice fields in North and South America was initiated by the American Geographical Society in 1948. A reconnaissance party of six visited the Juneau Ice Field in the Coast Range of Southeastern Alaska, worked out routes of approach, established campsites, and began a series of detailed observations. In the summer of 1949 a party of glaciologists, geophysicists, geologists, meteorologists, and botanists returned to the area. A grant from the Office of Naval Research and equipment and supplies provided by the Departments of the Army and the Air Force made possible the start of an intensive study of the ice field and its outflowing glaciers, the meteorological factors influencing them, and the geology, botany, and geomorphology of the areas adjacent to the ice. The Mount Washington Observatory, of Gorham, N. H., provided two of its meteorologists to make weather and climatological observations, and the Stanford Research Institute assigned two geophysicists, under the direction of its associate director, Dr. Thomas C. Poulter, to undertake measurements by seismic methods of the thickness of the ice. A botanical unit under the leadership of Dr. Donald B. Lawrence of the University of Minnesota studied the vegetation to determine recent glacier variations and the geomorphological chronology. Observations were also made of such features as the annual rate of accumulation of snow and the annual rate of ablation at different points on the glacier, its internal drainage, and its rate of movement. Mr. Maynard M. Miller, research assistant in glaciology at the Society, was leader of the ice-field party.

A Progress Report of the Juneau Ice Field Research Project, 1948, has been published and may be consulted at the Society. A report of the 1949 field work will be issued as soon as the results can be assembled and correlated.

A second component of the Society's Glacier Study Project is the program to be undertaken in South America during Southern Hemisphere summers. Initial field work was begun during the past winter when Dr. Robert L. Nichols, professor of geology at Tufts College, and Maynard M. Miller visited several of the glaciers of Argentine Patagonia. The work was undertaken jointly by the Society and the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" of Buenos Aires. This cooperation was most fruitful, and the Society is deeply indebted to the Director of the Museo, Dr. Agustín E. Riggi, and his staff for their courtesy and for their extensive aid in assuming the expenses and management of the field operations.

The principal areas visited were Lago Argentino in southern Patagonia and Lago Nahuel Huapí in the north. Various localities were investigated to determine the pattern of recent geomorphic developments, and several large glaciers were visited, notably the Moreno, which is now within a few yards of its most advanced position in several centuries. A report of the work is in course of preparation for publication in a forthcoming number of the *Geographical Review*.

Mr. Miller, who continued the work after Dr. Nichols' return to the United States, also visited Santiago, Chile, and Lima, Peru, to arrange for similar observations in those two countries. Through the courtesy of the Instituto Geológico del Peru, the Peruvian Air Force made possible a flight over the glaciers of the Peruvian Andes. Plans have been made for a continuation of field work in Argentina, Chile, and Peru during the coming winter, and for a third season of observations on the Juneau Ice Field in 1950.

New Sheets of the Millionth Map

In August, four completely revised sheets of the Map of Hispanic America 1 : 1,000,000 were issued: Pará (South A-22), Teresina (South B-23), Paraíba (South B-25), and Cayenne (North B-22). Aerial reconnaissance mapping completed within the last decade has greatly enriched the drainage detail of these sheets. Three additional revisions, Quito (South A-17), Iquitos (South A-18), and Río Mira–Islas Galápagos (North A-17), have reached the color-proof stage. When issued they will constitute, together with the 1948 edition of Piura (South B-17), a new base covering nearly all of Ecuador.

United Nations Conservation Conference

Mr. O. M. Miller represented the Society and Mr. C. B. Hitchcock the Association of American Geographers at sessions of the United Nations Scientific Conference on the Conservation and Utilization of Resources held at Lake Success from August 17 to September 6. Comments on some of the papers read at the conference may be found in Gilbert F. White's article elsewhere in this issue of the *Geographical Review*.

The Geographical Review

With this number Wilma Belden Fairchild assumes editorship of the *Geographical Review*. Miss Wrigley continues in an advisory capacity.

GEOGRAPHICAL RECORD

NORTH AMERICA

GEOLOGIC MAPS OF THE UNITED STATES. As a replacement of the Folios of the Geologic Atlas of the United States, published by the United States Geological Survey from 1894 to 1945, the Survey has recently inaugurated a series known as Geologic Quadrangle Maps of the United States. The geologic map of the quadrangle, supplemented by structure sections, columnar sections, or other graphic aids, has an accompanying text describing briefly the formations and economic geology of the quadrangle and including a short list of references to geological literature on the area. Where necessary, maps showing the economic, surficial, engineering, or other aspects of the geology will be published for individual quadrangles in addition to the map of the bedrock geology. The maps are available in two forms: flat, with a facing text page that forms a cover for the map, or folded, for greater convenience in filing and field use.

Another recent addition to the Geological Survey publications is the series of state geologic map indexes, of which some half dozen have been issued. These show, by colored outlines on a large base map, the areas covered by all published geologic maps on a scale larger than 1 : 2,500,000. "Each geologic map is identified by a number printed inside the outline. A key printed on the same sheet gives the source of publication, scale, date, and author of each geologic map. Twelve outline patterns in four colors indicate, without reference to the key, the approximate scale of each geologic map and whether the map shows the geology of the entire area outlined or contains blank areas."

PUBLICATIONS OF THE MAP INFORMATION OFFICE, U. S. GEOLOGICAL SURVEY. The Map Information Office of the United States Geological Survey has served the public to an extent that most persons do not realize. In addition to its function as a general consulting agency, the Office undertakes research in the field of map appraisal, distributes copies of government-owned photographs to other federal agencies and to the general public, and issues various map publications, all of which are useful to geographers. Among these last are a uniform series of index maps (scale 1 : 5,000,000) with accompanying explanatory pamphlets. Two of the maps show respectively all horizontal control and all vertical control established and reported by federal agencies (first editions, June, 1948). The work of the Geological Survey, the Coast and Geodetic Survey, and other agencies is differentiated by color.

"Aerial Photography of the United States" (third edition, April, 1948) shows areas known to have been photographed by or for federal, state, and commercial agencies. Where areas have, for special purposes, been photographed more than once, the coverage considered most suitable for average needs is shown as primary photography by color pattern; secondary photography is shown by black overruling. Ten categories of primary photography are differentiated according to the agency holding the film. The agencies listed are the Production and Marketing Administration, Soil Conservation Service, Forest Service, Geological Survey, Bureau of Reclamation, Tennessee Valley Authority, Corps of Engineers (Army), Air Force, and Coast and Geodetic Survey; finally, photography undertaken either by states or by commercial firms is indicated.

The status of topographic mapping in the United States and its territories and possessions

is given on two sheets (first editions, March, 1949). Map A shows the areas covered by maps on the standard scale of one inch to a mile or larger, Map B the areas covered by reconnaissance maps on the scale of one inch to a mile or smaller. Maps produced by the Geological Survey and by other agencies are differentiated. It should be noted that in 1948 the Geological Survey adopted map evaluation standards based partly on the criteria used in 1942 and partly on the criteria used later for classifying wartime mapping. These new standards now permit the evaluation of all topographic maps on a uniform basis. On Map A the quality of the mapping is shown by six classes: (1) best quality, (2) deficient in only one major element, (3) useful but requiring revision, (4) substandard, in need of resurvey, (5) planimetric maps compiled from aerial photographs, and (6) work in progress or scheduled. Essentially the same classification is followed on Map B, with two additional categories: (1) maps of low quality, some no longer published, and (2) planimetric maps compiled from various sources. Quadrangles heavily outlined in green indicate the map series on the scale of 1 : 250,000 published by the Corps of Engineers.

With all these index maps an accompanying text gives further details. Information concerning the availability of basic data may be obtained from the Map Information Office.

SOUTH AMERICA

BRAZILIAN CAMPO CERRADO: FIRE CLIMAX OR EDAPHIC CLIMAX. A recent paper by Felix Rawitscher on "The Water Economy of the Vegetation of the 'Campos Cerrados' in Southern Brazil" (*Journ. of Ecology*, Vol. 36, 1948, pp. 237–268) makes available for the first time in English some of the results of the author's extensive researches. The ecological relationships of the widespread *campo cerrado* or savannalike vegetation of South America have been much discussed, and widely differing opinions have been advanced. Dr. Rawitscher's point of view, quite logically, is that "the question whether the existence of their stunted and poor vegetation must be ascribed to the dryness of the climate, or to human interference, especially the annual burnings, . . . can be resolved only by examination of the water economy of these Campos." In other words, he asks the plants themselves to reveal the nature of their habitat. His conclusions are interesting, novel, and somewhat iconoclastic.

The region studied is in the vicinity of Emas in the Brazilian state of São Paulo (latitude 21° S.). It is neither humid nor arid, having an average of about 1400 millimeters (55 inches) of rain a year and a dry season of six months, during which less than 80 millimeters (about 3 inches) of rain is received each month. The soils are deep and porous. A permanent water table lies at a depth of 17 to 18 meters, and the subsoil below 2 or 2½ meters is permanently moist.

Most of the trees and shrubs are deep-rooted, penetrating to the humid subsoil and even to the water table. Such plants are more or less evergreen, and their leaves show high transpiration values. "They have no xerophytic character." Other elements of the vegetation are grasses, herbs, and shallow-rooted woody plants, which die down or become leafless in the dry season and perennate by means of underground stems or bulbs, some of which are extraordinarily well developed.

The evidence, as presented, shows no reason why the climax vegetation of this region should not be forest. Climatic conditions are such as support reasonably luxuriant forests elsewhere, and there would seem to be nothing in the soil conditions inimical to forest growth. It is stated that "fire-protected areas . . . can be brought to bear a dense tree-cover,"

and that the soil when cultivated yields good crops of fruit and sugar cane. Dr. Rawitscher would seem to be justified in describing the campo cerrado in this region as a fire climax. The fact that a large proportion of the vegetation is composed of shallow-rooted plants which suffer from the dry season is probably significant; abundant moisture would be available to plants of deeper rooting habit, but the shallow-rooted plants are here because they are adapted to withstand the periodic fires, which most deep-rooted mesophytic forest trees are not. Those deep-rooted plants which are present must be specially protected against fire (for example, by thick bark) and against the rigorous insolation, low humidity, and so on of the depauperate fire-climax vegetation.

It would seem to be too strong an assumption, however, that these conditions obtain universally in the Brazilian campo cerrado. The fire-climax vegetation at Emas has probably been introduced, but its source is not necessarily the drier regions to the northwest, as Rawitscher concludes. The writer's experience with analogous savanna vegetation in Venezuela and the West Indies suggests that we should look for it not as a climatic climax but as an edaphic climax, and as such it may be present not far from Emas.

In this connection, Dr. Leo Waibel's recent paper on "Vegetation and Land Use in the Planalto Central of Brazil" (*Geogr. Rev.*, Vol. 38, 1948, pp. 529–554) is of great interest. It gave the writer a somewhat different impression of the campo cerrado from that obtained from Rawitscher. The region Waibel studied is farther north, on the central plateau proper, and in savanna country par excellence. Here are found all the conditions that, by analogy with northern South America, the writer would expect in association with savanna vegetation: an extensive peneplain, nearly horizontal or slightly undulating, undissected by minor watercourses and dotted with lakes and ponds; and ancient soils, sandy at the surface and containing layers of ironstone concretions or massive ironstone sheeting. The campo soils here are considered infertile and unfit for cultivation, and although Waibel makes a gallant plea for their utilization, it does not seem that they will readily lend themselves to anything but the least exacting crops, such as cassava and pineapples. Soils are not described in detail by Waibel, a rather surprising omission, since he was making a special study of land use, and soil investigations should surely form an important part of this. From what we are told of the soils, and certainly from the geomorphology, we can picture here a typical South American savanna region. The writer entirely supports Dr. Waibel in his view that "the campo cerrado is a vegetation type *sui generis*," that it is "a natural, climax vegetation, and not a forest degraded and deteriorated by human interference."

We know from other parts of South America that, as a result of clearing and burning, savanna will extend itself onto former forest land. This has presumably been the case at Emas, the source of the savanna flora being the central plateau proper, where the savanna existed as a natural climax. The next question that arises is, what kind of climax is it? Rawitscher and Waibel agree, and the writer supports them, that the conception of South American savanna as a climatic climax must be totally discarded. For the central plateau proper, Waibel further found the evidence to be against savanna as a fire (deflected) climax. We must conclude, therefore, as Waibel did, that it is an edaphic climax, dependent on the nature of the soil as the prime ecological factor. If this is so, then what differentiates savanna soils from forest soils?

This is a question that has been answered by pedologists (see, for example, H. H. Bennett and R. V. Allison: The Soils of Cuba, Tropical Plant Research Foundation, Washington, D. C., 1928; and C. C. Charter: Reconnaissance Survey of the Soils of British Honduras,

1941), but their work has not received the attention it deserves. Waibel realized clearly enough that savanna soils are distinct, but he is vague as to details. "The soils are very different from those of a forest: they are generally sandy and definitely less fertile and drier than forest soils, and humus is absent. A surface crust, resulting from the annual fires and capillary-water action in the dry season, is common." Waibel correlates the distribution of forest and savanna with geology and concludes that certain rocks produce forest soils and others campo soils. This is something that should be carefully checked, and checking is difficult if the country rock has decayed to a great depth.

The writer wishes to put forward the following observations for consideration by students of this subject:

1. Natural drainage is the most important characteristic of tropical soils affecting distribution of vegetation; chemical status is of little account.

2. The soils of upland forests are well drained, by virtue of porosity or relief or both.

3. The natural drainage of savanna soils is affected unfavorably by the lack of relief and the internal physical structure. Usually savanna soils exhibit the superposition of a horizon permeable to water and penetrable to roots upon one that is impermeable or impenetrable or both (for example, sand over clay or iron pan), or else they are extremely compact and impermeable throughout the profile, so that no true water table exists.

4. Savanna (or campo) may be characterized as the vegetation of the highly mature soils of senile landforms (or, in some cases, of very juvenile sites) that are subject to unfavorable drainage conditions in the form of intermittent perched water tables, with alternating severe periods of waterlogging and desiccation.

It is accepted that savanna may extend itself as a fire climax onto areas where conditions of soil or topography already partly approach those characteristic of savanna. Rawitscher would seem to have been studying such an area. For a full elucidation of the conditions on the central plateau we should need a study of the physical structure of the soil, particularly its differentiation into textural horizons and the behavior of ground water. We should know the nature of the water table, if any, and whether the roots of the savanna trees succeed in reaching it by penetrating the ironstone layer. If they do, then there is a clear reason for their presence, namely that they are adapted to accomplish what is impossible for other species. If they do not, then their water economy should be investigated, since it must differ from the pattern determined by Rawitscher.—J. S. BEARD

FISH RESOURCES OF THE PATAGONIAN CONTINENTAL SHELF. Serious depletion of the food resources of the earth's land areas directs attention more sharply than ever before to the exploration of the food resources of the sea. Of late, interest has centered particularly on the low consumption of sea fish in the South American countries except Venezuela and the Guianas, which rank high among the fish-consuming countries of the world ("Computing Human Consumption of Fish," *Fisheries Bull.*, FAO, United Nations, Vol. 2, 1949, pp. 22–36). Although little in the way of surveys of South American fishing potentialities has been available, it has been the general opinion that the low consumption is due to the underdevelopment, or in some countries the total lack, of commercial fisheries rather than to any paucity of fish. Of the fishing areas believed to possess particularly high potentialities, the Patagonian continental shelf has been judged by experts to be even richer in edible species than the North Sea (Murray Frank: Fisheries of South America, *Foreign Commerce Weekly*, Vol. 14, No. 13, 1944, pp. 8–15 and 42–44). However, three detailed surveys carried out in

1927, 1928, and 1931–1932 under the direction of the Discovery Committee seem to have demonstrated conclusively that the shelf is poor not only in number of species but also in density of its few edible species (T. J. Hart: Report on Trawling Surveys on the Patagonian Continental Shelf, *Discovery Repts.*, Vol. 23, 1946, pp. 223–408).

The Discovery Committee surveys covered an area of some 150,000 square miles—considerably larger than the North Sea—extending south from 42° S. to Staten Island and having an average width of 250 miles, the "largest expanse of shoal water (accessible to trawling) in the 'cold temperate' or sub-Antarctic Zone of the southern hemisphere." Ninety-five species of fish were recorded, less than one-third of the number found in British waters and only a little more than half of that recorded for the Gulf of Maine. Moreover, there were found to be large qualitative differences from the types of fish known in the Northern Hemisphere. Gadidae, the large family that includes cod, haddock, pollack, etc. as well as flatfish, are relatively unimportant, and Salmonidae—salmon, trout, smelt, grayling, etc.—of useful size are entirely lacking. The only edible fish found in sufficient quantities to suggest the possibility of commercial exploitation was hake, and that only in the northern section of the shelf. The paucity of fish on the shelf is evidently due to several local factors, though scarcity and small size of flatfish and Salmonidae are characteristic of all the known fishing grounds of the Southern Hemisphere. The surveys indicated a much poorer phytoplankton than that in the waters off the west coast of South America. Around the Falkland Islands the presence of large numbers of sea lions unquestionably contributes to the scarcity of fish, since not only is it now known that sea lions feed largely on cephalopods, one of the most important fish foods, but there is little doubt that they also eat great quantities of fish.

The primary object of the Discovery Committee investigations was to assess the prospects for commercial fishing from the Falkland Islands. The conclusion reached was that the small and scattered population of the islands, together with the fact that the best trawling grounds are at a considerable distance, makes it unlikely that even a single large trawler could pay its way on local trade alone. A hake fishery, even in the northern section of the shelf, could barely show a profit even if markets equivalent to the British market were available within a few hundred miles.

EUROPE

ROADS, RIVERS, AND REGIONS OF ENGLAND. "The parish of Selborne lies in the extreme eastern corner of the county of Hampshire." When, in 1789, Gilbert White began his "Natural History of Selborne" with this geographical statement, he also opened a special field of regional literature in which English writers have excelled. The names of Richard Jefferies, W. H. Hudson, and Henry Williamson at once come to mind. Part of the charm of "Selborne" lies in the combination of accurate observation and undemonstrative affection for the district and its wildlife, a combination of intellect and heart that lies at the root of good regional writing.

Thanks to observational powers and sympathetic understanding, the novel or essay may come nearer to capturing the spirit of a place—the *genius loci*—than the most painstaking thesis of a graduate geographer. Nothing in the textbooks, to my mind, has equaled in geographical feeling the description of the southern Pennines by C. E. Montague in "The Right Place" (1924). But if the geographer's methodical analysis of a landscape and its life tends to be labored and to suffer from lack of imagination and stilted phraseology, the other

extreme of sentimental extravagance is far worse and easily degenerates into a militant and ignorant parochialism.

A sample of popular books on various regions of England recently received at the American Geographical Society is, like the traditional curate's egg, good in parts, but on the whole it makes the scientific reader despair that a generation of higher education in geography and the natural sciences has had so little effect on the standards of public taste.

For an avenue into the regions we may take Geoffrey Boumphrey's "British Roads" (Nelson, London, etc., 1939; reprinted 1948), one of a series (Discussion Books) designed for the serious reader, to which Professor W. G. East has contributed "Mediterranean Problems" and "The Geography behind History." Admirable though the book is as a historical survey, the geographer will find it lacking in scientific sense. The author starts off on the wrong foot by accepting with little reserve "The Old Straight Track" hypothesis of Alfred Watkins, better known for his other inventions. His main concern is with the roads of the present, their functions and amenities. Here the American parkways might have been cited in addition to the *Reichsautobahnen*.

Four books in the bundle deal with rivers or river valleys. J. W. Kempster's "Our Rivers" (Oxford University Press, London, etc., 1948) is a solid study of river pollution by sewage and trade effluents. As they say in Manchester; "The quality of Mersey is not strained." But here, as in other aspects of British life, the tide of laissez faire is fast ebbing, and the task of rehabilitation is under way. Neither plant nor animal life can subsist in many stretches of English rivers; not even the eels can pass the deadly barrage of the London sewers. The book is packed with information, and detailed appendixes give catches of fish, fishing districts, and proposed administrative reforms. Special attention is paid to the salmon and its migrations, partly because this fish is a good judge of fresh water and serves as an ecological index of pollution. The Salmon and Freshwater Fisheries Act, which closely defines the conditions under which the fish may be caught, casts its legislative net as widely as possible by listing no fewer than 50 names for the salmon in its various stages of growth (neither the "swing" nor the "gilleon" of the lower Severn is listed, though they are presumably covered under "any other local name"). In such ways as this "Our Rivers," though it looks at its subject from the viewpoint of the administrator and the lawyer rather than that of the regionalist, brings out the character and individuality of the rivers of Britain.

In contrast, John Rodgers uses the "English Rivers" (Batsford, London, etc., 1948) as an excuse to wander from one town to another along their banks, watering his pages liberally with quotations from the writers they have bred. There is no scientific interest here, except for the student of photography—like all other Batsford books, this one is beautifully illustrated. Dubious etymology, which holds a fascination for the popular writer, leads to the marking, on the bare outline map provided, of the upper Severn as the Vyrnwy and the lower Avon as the Severn. But a good deal of curious information has been collected for those who care to dig for it. More seriously, it may be noted that the drowned river mouths of the West Country, from Avonmouth round to Dartmouth, provide deep harbors, which attracted settlements, and these settlements rightly took their names from the rivers, including Plymouth and, less obviously, Tavistock.

"Severn Tide" by Brian Waters (Dent, London, 1947) is a charming and absorbing study of man and nature in the tidal estuary of the Gloucestershire Severn, written with such a fund of local knowledge and affection that one forgives occasional overstatements. It is a definite contribution to our understanding of a many-colored county. A large part of

the book is devoted to descriptions of the arts and crafts of salmon and eel fishing, by spear and net, and by basket weirs of "putts, half-weels and weels." These ancient and decaying crafts are described with that blend of wonder and understanding which is the mark of genuine regionalism. Their contribution to the fabric of local life is well brought out. I like the suggestion that the mystery of an ancient craft lies behind the attitude whereby "a salmon fishermen will never tell the truth if he can help it."

"Tideways and Byways in Essex and Suffolk" by Archie White (Edward Arnold, London, 1948) is anecdotal and facetious. Its chief value lies in a series of line drawings of tidal villages, windmills, churches, ships, and nautical gear.

Douglas M. Ramsden's "Teesdale" (Museum Press, London, 1947) comes somewhere between a guidebook and a regional essay. One hesitates to use the epithet "pedestrian" even for a book designed for the walker, but in the sense that this is a serious, straightforward, down-to-earth account of the Pennine Tees Valley that is perhaps the best adjective to apply to it. It is lit with an unpretentious feeling for country which is somehow appropriate to the north of England. Archeological and historical information is happily blended with local gleanings, and an appendix on the flora of Upper Teesdale strengthens the appeal to the serious rambler. There is a rapidly growing demand for books of this sort, supplementing the old-style guidebook with the results of field studies of many kinds. Clearly, geographers can make special contributions here, and one hopes that they will be called upon to write them.

More frankly factual is "The Winchester Countryside" by Alan Rannie (Allen Unwin, London, 1947), which is described as a guide to the country surrounding Winchester and does not pretend to be anything else. It has all the traditional guidebook attachment to churches and old castles, and more than its share of detachment.

A "County Books" series edited by Brian Vesey-Fitzgerald (Robert Hale, London), like other series of this kind, is apt to be a mixed bag of the personal whims and prejudices of writers of various calibers. Except as light reading, the volumes on Surrey (by Eric Parker) and Stafford (by Phil Drabble) are disappointing. Hopefully we turn to Batsford's "Face of Britain" series, represented by J. H. Ingram's "The Heart of the English Midlands" (London, etc., 1948). The author describes himself as a land worker whose present concern is the regeneration of British agriculture. Personal bias is strong, and despite the author's gift of uncovering much interesting regional detail, the general approach is along "the delectable byways of local history, biography, archaeology and folklore." Finally there is Sydney R. Jone's "England South" (The Studio, London and New York, 1948), the first of three volumes that will "embrace the whole of England." This is a more mature study in the same genre, built around a large collection of charming pencil sketches of English scenes.

In summary, the writings on the regions of Britain have, with few exceptions, hardly changed since the beginning of the century. The recipe is still "the mixture as before": a dismal base of topography and geology, a solid hash of historical meat taken from Camden, Leland, Aubrey, Cobbett, and so on, not forgetting Izaak Walton, the whole well laced with dubious etymology, scraps of folklore, and a druid or two, spiced with the amorous adventures of kings and queens, and sprinkled with anecdotes and appropriate verse.

This is a long way from the tradition of Gilbert White. One might have hoped that at least some of the more widely publicized achievements of geographers—such as the Land Utilisation Survey—would find their way into the text and the spirit of publications called

forth to meet a genuine and growing interest in local life, landscapes, and customs.—E. ESTYN EVANS

AFRICA

NEW SCIENTIFIC INSTITUTIONS IN FRENCH BLACK AFRICA. Scientific research in French Black Africa has been greatly stimulated in recent years by a number of newly created institutions (Charles Robequain: Les nouveaux instituts scientifiques dans les terres françaises d'Afrique noire, *Annales de Géogr.*, Vol. 57, 1948, pp. 360–362). In spite of a dearth of personnel, equipment, etc., the Institut Français d'Afrique Noire (IFAN) at Dakar is carrying out a varied program and has established branches in the other territories of French West Africa. It is being helped by the Office de la Recherche Scientifique Coloniale (ORSC, created in 1943 to coordinate and intensify study of the tropical regions of the French Union), which has instituted new training for specialists, helps already existing centers, establishes new ones, organizes field work, and initiates and promotes studies of colonial problems in France.

Accomplishments in the field of physical geography include the establishment, near Abidjan, of a center for the study of tropical biology and the carrying out of soil studies in Senegal, the inland delta of the Niger, and the Ivory Coast. Among the projects not yet completed are the establishment of a laboratory in the inland delta of the Niger for the study of fresh-water flora and fauna; botanical and zoological inventories of Mt. Loma (Sierra Leone), Mts. Nimba and Tonkoui (on the borders of Guinea, Ivory Coast, and Liberia), and of the Bignona (Casamance) region; and a phytogeographical map of French West Africa.

In the field of human geography IFAN plans to publish an ethnodemographic map of West Africa, accompanied by an accurate and complete index of the population. Food and nutrition are being studied in cooperation with the Organisme d'Enquête pour l'étude anthropologique des populations indigènes. A well-equipped linguistic center is being created at Lomé (Togoland), and numerous ethnological studies have been undertaken, notably among the Dogons and the Bambaras of the Sudan, by IFAN and by research workers from France. J. Richard-Molard is making a study of the human and physical geography of the Rivières region (lower Guinea). An exhaustive analysis of the geography of stock raising in the Sahel region of Mauritania, Senegal, and Sudan (by F. Bonnet-Dupeyron, on the staff of ORSC) has produced a series of six maps on the scale of 1 : 5,000,000 and a provisional map of nomadism and transhumance in Mauritania (2 sheets, 1 : 1,500,000).

Unfortunately, lack of both funds and paper has limited publication of the results of research and field work. *Notes Africaines* (quarterly, published by IFAN) continues to furnish brief and often valuable communications, but the larger *Bulletin* stopped with the fourth issue (January–April, 1940).

The Institut at Dakar is cooperating with similar organizations in the other territories. A local center at Douala (Cameroons) publishes a bulletin (started December, 1935) which contains résumés, original studies, and bibliographies, with emphasis on natural history. One of its articles most useful to geographers is A. Vaillant's "La flore méridionale du lac Tchad" (March, 1945). Another valuable contribution is "L'agriculture chez les Ndiki," by Mme. R. Dugast (December, 1944). Many of the necessary documents for a complete inventory of the population and for an ethnodemographic map of the Cameroons have been collected at the Douala center, and part of this material has recently been published (I. Dugast: Inventaire

ethnique du Sud-Cameroun, *Mémoires Inst. Français d'Afrique Noire, Centre du Cameroun,* Série: Populations, No. 1, 1949).

French Equatorial Africa is less well equipped for scientific research, but strenuous efforts are being made to expand. The Institut d'Études Centraficaines, created in 1946, with headquarters at Brazzaville, published the first issue of its *Bulletin* in 1945 (replacing the bulletin of the Société d'Études Congolaises, 1922–1941).

Contact with field work and studies undertaken in neighboring countries has been established and maintained through congresses, initiated by IFAN. The first of these was held in January, 1945, at Dakar, the second in February, 1947, at Bissao (Portuguese Guinea).

ASIA

THE HILL STATIONS AND SUMMER RESORTS OF THE ORIENT. In our article with this title (*Geogr. Rev.*, Vol. 38, 1948, pp. 637–651) we did not attempt to list every place used by Occidentals and Orientals for recreation. An all-inclusive list would run to perhaps 250 sites scattered from the Afghanistan hill borders of India to northern Japan, many of them of purely local use. However, it appears that we did omit a number of important and well-frequented resort stations. Mr. Rowland Bowen writes from Batavia to suggest some additions in India and the Indies. Of the 15 Indian stations contained in his list, six seem, on checking, to be comparable to those shown on our map. These are: Ziarat, Baluchistan, elevation 8000 feet, 410 miles southwest of No. 81 on our map; Cherat, North-West Frontier Province, 4500 feet, 85 miles southwest of No. 81; Parachinar, about 5700 feet, 190 miles west of No. 81; Nathia Gali, 8500 feet, north of No. 80 and east of No. 81; Dalhousie, Punjab, 6600 feet, midway between Nos. 74 and 76; Dharmsala, Punjab, 7000 feet, also midway between Nos. 74 and 76.

Obviously, criteria differ, and nothing short of traffic counts and a complete canvass of all stations would provide an objective basis of agreement. Dalhousie and Dharmsala are serious omissions; they are two of the best of the northwest Indian stations.

Mr. Bowen also suggests two additional stations in the Indies, one in Java, the other in Sumatra. In Java, Poentjakapas lies between Nos. 50 and 52 at an elevation of 4000 feet. In Sumatra, Berastagi, 4500 feet, lies in the hills behind Medan.

A further check of some additional Indian sources would also suggest inclusion of the following important Indian stations at this opportune time: Chail, 7400 feet, 20 miles south of No. 74; Chikalda, Berar, about 3600 feet, in the Satpura Hills, 100 miles southwest of No. 83; Panchgani, Bombay, 4300 feet, 55 miles east of No. 92; Palmaner, Madras, 2200 feet, 25 miles southeast of No. 95.—J. E. SPENCER AND W. L. THOMAS

AUSTRALASIA AND OCEANIA

RECENT CLIMATIC STUDIES IN AUSTRALIA. Only rarely does one find a geographer who is primarily interested in climatology and who at the same time has had sufficient training in mathematics, physics, and biology to deal more than superficially with climatic problems. Dr. J. Gentilli, professor of geography in the University of Western Australia at Nedlands, is such a geographer. His recent publications include "Rainfall and Climate in Western Australia and the Rainfall-Wheat Relationship," 1946 (mimeographed); "Climatic Regions: A Review of Koeppen's and Thornthwaite's Systems as Applied to Australia," 1946 (mimeographed; summarized in the *Australian Journ. of Sci.*, Vol. 11, 1948–1949, pp.

13–16); "Climatic Regions [of] Tasmania," 1 : 1,000,000, 1947; and "Bioclimatic Controls in Western Australia" (*Western Australian Naturalist*, Vol. 1, No. 6, 1948).

The paper dealing with the application of two systems of climatic classification to Australia (and its summary) follows a familiar pattern. Gentilli rightly criticizes the use of the terms "macrothermal," "mesothermal," and "microthermal" in the Thornthwaite classification, pointing out that they convey the idea of size, which can hardly be applied to temperature. In the new Thornthwaite classification (*Geogr. Rev.*, Vol. 38, 1948, pp. 55–94) the series has been somewhat improved by the substitution of "megathermal" for "macrothermal," but there is a strong case for Gentilli's suggested terms, "hot," "warm," and "cool." Noteworthy is the inclusion of two maps of Australia on the large scale of 1 : 10,000,000 showing the distribution of climates according to the two systems. The map on the Thornthwaite system is printed in full color and contains considerable additional detail.

The map of the climatic regions of Tasmania also utilizes the Thornthwaite system and is in full color. It shows clearly that climatic differences exist even in so small an area—10 distinct climatic types are found on the island. As with the smaller-scale map of Australia, valuable details have been added.

The paper on rainfall and climate in Western Australia has several noteworthy features. There are 56 maps and diagrams, presumably drafted by the author, many of which present entirely new details of climate. For example, two series show the standard deviation of rainfall and the variation coefficient for each month. Gentilli points out that since the standard deviation is expressed in inches of rain, it has an absolute value only, whereas the coefficient of variation, which is the standard deviation expressed as a percentage of the mean from which it is computed, provides a relative value for practical comparison. This coefficient of variation decreases from March until June-July (midwinter), when rains become most regular. The area of small variation moves northward from March to June-July and recedes southward from August to October. There are also detailed maps of average annual number of wet days, mean rainfall per wet day, mean deviation of annual rainfall, agricultural-drought probability, probable number of years per century with less than 12 inches of rain, and climatic regions according to Köppen and Thornthwaite, and a map of rainfall effectiveness according to Thornthwaite. The larger part of the paper is an attempt to determine a relation between rainfall and acre yields of wheat. Correlation coefficients between monthly rainfall and yield have been computed and mapped (compare the maps in J. K. Rose: Corn Yield and Climate in the Corn Belt, *Geogr. Rev.*, Vol. 26, 1936, pp. 88–102) for every month of the year for 58 districts in Western Australia.

Optimum monthly rainfall is determined by a novel method—a series of graphs for the 12 months in which rainfall is plotted on the ordinate and correlation coefficient on abscissa. When the rainfall of a month is too low, the correlation is positive, meaning that more rainfall would result in increased yield; when the rainfall is too high, the correlation is negative, meaning that yield would be greater if rainfall were less; when there is no correlation, the rainfall is assumed to be at the optimum. A graph of the march of mean and optimum rainfall through the year shows that from April through October rainfall in the wheat district is deficient, with the greatest deficiency in August and September.

"Bioclimatic Controls in Western Australia" is the first paper to apply the concept of evapotranspiration to climatic conditions in Australia. Five maps show the distribution of potential evapotranspiration in Western Australia for January, May, July, September, and November; three maps show the number of months in which the potential evapotranspira-

tion exceeds 16, 10, and 5 centimeters. There are two maps of water deficit, one giving the number of months with a water deficit greater than 5 centimeters (indicating also the period of the year in which the deficit occurs), the other the number of months with a water deficit of any amount. There are also two small inset maps of water surplus in the southwest corner of the district. Gentilli finally works out the moisture index, which he calls the "hygrostatic index," and maps the hygrostatic regions of Western Australia. One hopes that he is at work on a similar series of maps of the whole of Australia.—C. W. THORNTHWAITE

PHYSICAL GEOGRAPHY

UPWELLING WATER, FISH MORTALITY, AND PETROLEUM. Many mass mortalities of fishes and other aquatic organisms have been reported from various seacoasts. They are striking events: the beaches are littered with millions of dead and dying fish, sometimes to a height of several feet. Margaretha Brongersma-Sanders has compiled an extensive list of such catastrophies and shows that they recur at irregular intervals in the same localities (The Importance of Upwelling Water to Vertebrate Paleontology and Oil Geology, *Verhandelingen Kon. Nederl. Akad. van Wetenschappen, Afd. Natuurkunde,* Sect. 2, Vol. 45, No. 4, 1948). Whatever the cause, there seems no reason to doubt that they also took place in the past, so that Dr. Brongersma-Sanders' suggestion that they may be the origin of some of the crowded layers of fossil fish seems highly plausible. Her conclusion that large-scale fish mortalities occurred repeatedly where some of the source beds of petroleum were deposited and that the fish played a part in the genesis of the petroleum is not as well established but may prove to be a reasonable inference.

The causes of these piscine catastrophies are not yet clear. They almost always happen where upwelling of deeper water to the surface is frequent; discolored water, often red or yellowish red, has frequently been observed before and during the fish mortality. Dr. Brongersma-Sanders observed the phenomenon at Walvis Bay, South-West Africa, in 1938 and made a particularly detailed study of the reports of 17 other mortalities between 1837 and 1943, from which, by a process of elimination, she identifies as the causative factor the dinoflagellates which also cause the redness of the water. After examining reports of mortalities in other regions, she concludes that the frequent coincidence of upwelling and discolored water with the mortalities justifies a generalization of this conclusion. Although this sort of *post hoc, ergo propter hoc* reasoning is not convincing, recent studies of the "red tide" that appeared off southwestern Florida in 1927 (Galstoff, *U. S. Fish and Wild Life Service Special Scientific Rept. No. 46,* 1948) indicate that the dinoflagellates may indeed be the culprit causing most catastrophic fish mortalities. Galstoff and his associates found that the fish mortalities ceased with the disappearance of the "red tide" and that an extract of *Gymmodinium,* the dinoflagellate which caused the "red tide," when redissolved in water, killed experimental fish, producing symptoms very similar to those observed among the fish in the "red tide." They conclude that these data "provide sufficient ground to suspect the Gymmodinium as the principle cause of the mortality."

The reason for the sudden enormous growth of dinoflagellates is obscure. It is easy to talk about the right combination of temperature, light intensity, and chemical composition of the water, but unfortunately we do not have any detailed knowledge of the requirements of any of the species of dinoflagellates that have been detected in the fatal outbursts. Neither are there available adequate surveys of the physical condition of the sea water directly before and during the mortalities. Upwelling may often bring to the surface increased concentrations

of nutrient salts, but no direct evidence seems to be available to show to what extent upwelling contributes to the production of a fatal crop of dinoflagellates.—JOHN C. ARMSTRONG

SOLIFLUCTION, PAST AND PRESENT. At sea level in polar and subpolar regions and in higher altitudes of the middle and lower latitudes solifluction is today an effective process of denudation, far surpassing in its accomplishments the mass movements that take place in warmer regions. From the "fossil" soil patterns, block streams and fields, and rounded surface forms it left behind, we know that it was active during the Ice Age in periglacial regions of the middle latitudes. These regions are now, however, below its lower limit, which is several hundred to a thousand meters below the present snow line. Like the latter the lower boundary of solifluction rises toward the equator, where it is about 4000 meters above sea level, and toward dry regions such as Tibet, where it reaches a maximum elevation of more than 5000 meters above sea level. This distribution is described and mapped by C. Troll in a recent review of the character and significance of solifluction (Die Formen der Solifluction und die periglaziale Bodenabtragund, *Erdkunde,* Vol. 1, 1947, pp. 162–175; see also his "Strukturböden, Solifluktion und Frostklimate der Erde," *Geologische Rundschau,* Vol. 34, 1944, pp. 545–694).

According to Troll, solifluction should be defined as a special type of climatically controlled mass movement associated with alternate freezing and thawing of the ground. The thawed layer, saturated with water, creeps and flows easily, even on nearly level surfaces. Its movement may be differential, forming distinctive soil patterns (Strukturböden), or it may be relatively uniform or "amorphous." It may be radial, within a pattern element such as a stone polygon, or it may be downslope. The alternation of freezing and thawing may take place frequently—every day or every few days—or it may be seasonal. Short-period alternations are characteristic of high altitudes in the tropics and of pronounced marine climates in higher latitudes. Under such conditions only a thin surface layer of soil, at most a few centimeters in thickness, is affected at any one time, but because the process is active throughout the year the resulting "solifluidal" denudation, as Troll calls it, is great. Soil patterns formed in such regions are of the tropical type, miniature in size, with an inner diameter of only 10 to 25 centimeters. In polar regions, on the other hand, the alternation of freezing and thawing is seasonal. Here there is typically a zone of permanently frozen ground, the pergelisol of Kirk Bryan (Cryopedology—the Study of Frozen Ground and Intensive Frost-action with Suggestions on Nomenclature, *Amer. Journ. of Sci.,* Vol. 244, 1946, pp. 622–642), of which only the upper part, Bryan's supragelisol or mollisol, thaws. Thawing may reach depths of several decimeters to several meters, causing the masses of material that are saturated and set in motion to be much thicker than in the tropics. Soil patterns formed when the movement is differential are also larger, having an inner diameter of a meter or more (polar type).

In Troll's opinion solifluidal denudation has not been given the recognition it deserves. Because it contributes significantly and over rather widespread areas to the wearing down of the earth's surface he believes it should be classed as an independent type of denudation, comparable in rank to glacial, marine, eolian, and fluvial denudation.—ERNST ANTEVS

HUMAN GEOGRAPHY

CLAIMS TO THE CONTINENTAL SHELF. The establishment by unilateral proclamation of claims to jurisdiction and control over the natural resources of the continental shelf

and the sea above it is a relatively new development in international practice. In the October, 1948, number of the *American Journal of International Law*, Richard Young of the Harvard University Law School outlines the action taken by the United States, Mexico, the Argentine Republic, Nicaragua, Chile, Peru, and Costa Rica and a similar procedure proposed by Cuba (Recent Developments with Respect to the Continental Shelf, Vol. 42, pp. 849-857). Some of the claims relate to jurisdiction and control, others to sovereignty—under the circumstances, a largely verbal distinction. An interesting feature is the self-interest nature of the definitions of "continental shelf," especially where the shelf is narrow and great depths of water closely approach the shore line. The claims of Chile, Peru, and Costa Rica reach to a limit 200 miles offshore, regardless of depth of water. The United States, Mexico, and Nicaragua hold more to the usual ideas of the continental shelf: a depth of 100 fathoms marks the territorial limit of the United States claim, 200 meters the Mexican and Nicaraguan claims. The Cuban proposal defines the insular shelves as reaching to the 200-fathom line. Argentina makes no definition, a "lack of precision" that "may be of practical importance in connection with Argentina's Antarctic claims."

The author points out that a similar unilateral establishment of claims is not practical where several states border the same shelf or merging shelves, as in European waters or in Arctic waters; and he cites as a possibly useful precedent in such cases the treaty of February 26, 1942, between Venezuela and the United Kingdom relating to the submarine areas of the Gulf of Paria.—HAMILTON HADLEY

OBITUARIES

WALLACE W. ATWOOD. Wallace W. Atwood, president emeritus of Clark University, founder of its Graduate School of Geography and head for 26 years, died at his summer home in Annisquam, Mass., on July 24, at the age of 76.

Attempting to answer the question what made him choose geography at a time when graduate work in that field was still unknown, my thoughts go back to a talk I had with him a few weeks before his death. He spoke to me at some length about the great men he had known, and before all of them he put Rollin D. Salisbury, his major professor at the University of Chicago. I quote from his notes on Salisbury's first field course in geology: "This was an adventure in education for him and for all the class. I think it was the first systematic field course in geology in America. . . . The work was fascinating. The students were allowed to discover things by themselves. Many days passed without any help in the field. We must discover the problems and go to work to solve them. We were like chemists working in a laboratory with "unknowns"—but what a laboratory! . . .

"Several in this little party with Professor Salisbury found in the field work inspiration and joy that guided them into professional careers. Hundreds of youths who worked with that man indoors and in the field were led to choose careers in which his lessons in geology were of basic significance. His training in exact thinking and exact expression was also of basic importance in their lives. He was a great teacher."

Those last words can also be used as the basis for an evaluation of Wallace Atwood's own career. He too was a great teacher, and what he taught was love for, and understanding of, nature and mankind—in other words, geography. He liked to stand in front of a class, be it a fourth grade or a group of graduate students, and talk to them about various parts of the world. He knew that world well, having studied it for more than half a century and having traveled over most of it. And he was a good traveler, as I know from a visit with

him and Mrs. Atwood to parts of the Mediterranean basin in 1938. His last long trip, to New Zealand and Australia, which he made this past winter in order to attend the Pacific Science Congress, had originally been planned to include southern and southeastern Asia and would have completed his world survey.

Dr. Atwood's love of nature expressed itself in many directions. He wanted to show nature to those who could not travel and see it themselves. The exhibits he prepared as secretary and director of the Chicago Academy of Sciences showed plants and animals in their natural setting, an idea that was used later for the Field Museum. In Cambridge he was instrumental in starting the Children's Museum, where, to quote his own words, "literally thousands of the public school children came to receive lessons that were planned definitely, so that they became an integral part of their school work." In his later years he gave a considerable amount of attention to the making of geographic motion pictures that would be used to enrich school textbooks and bring the world into the classroom.

Wallace Atwood received his education at the University of Chicago, and it was also at this university that he was given his first important position. He was on the teaching staff from 1901 until 1913, rising from instructor to full professor in the Geology Department under Thomas C. Chamberlin and Rollin D. Salisbury. During his Chicago years he started his field work in the Rocky Mountains, a work that he continued up to his death. Even in 1948, at the age of 75, he again spent the summer in those mountains, checking and rechecking his results. Although his monograph on the San Juan Mountains was his largest purely scientific publication (W. W. Atwood and K. F. Mather: Physiography and Quaternary Geology of the San Juan Mountains, Colorado, *U. S. Geol. Survey Professional Paper 166*, 1932), he wrote numerous technical articles in the field of physiography, and many were the papers he gave before the Association of American Geographers, including his presidential address, "The Increasing Significance of Geographic Conditions in the Growth of Nation-States" (*Annals Assn. of Amer. Geogrs.*, Vol. 25, 1935, pp. 1–16). In 1945 he contributed a popular volume on the Rocky Mountains to the American Mountain Series (reviewed in the *Geogr. Rev.*, Vol. 37, 1947, p. 343). In this book he tells much about the mountains he knew so well, about field research methods, and about himself that will interest the general reader.

In 1913, Atwood was called to Harvard to occupy the chair vacated by the retirement of William Morris Davis. It was while there that he became interested in the writing of grade-school textbooks, and from 1919 on he was the author and coauthor of a long series of textbooks that carried modern geography into all corners of this country. He consistently promoted and demonstrated the regional approach, both in his books and in the wall-map series prepared under his direction. On his deathbed he was still working at his writing; a new book planned but not completed was intended for use in junior high schools, "An Introduction to World Understanding—A Social and Economic World Geography." In the college field his chief contribution was his textbook "The Physiographic Provinces of North America."

In 1920 he accepted an invitation from the Board of Trustees of Clark University to start a Graduate School of Geography and at the same time to become president of the university. He remained at Clark until his retirement in 1946. This was probably his most productive period. He drew to the faculty many fine scholars both from home and abroad and along with that staff attracted, over his quarter of a century of service, hundreds of graduate students from more than a score of countries. Nor did he neglect to inspire his family, and his two sons, Rollin S. and Wallace W., Jr., followed in his footsteps and are

now well-known geographers. The School of Geography became his life, and the name of Clark as a center of geographic training will be forever associated with his name.

Many were the honors that came to him. He was president both of the National Council of Geography Teachers and of the Association of American Geographers. He received Service Awards from the University of Chicago and from the National Council of Geography Teachers, and the Helen Culver Gold Medal of the Geographic Society of Chicago. He was president of the National Parks Association and of the Pan American Institute of Geography and History, and he represented the United States at many international conferences. His death is a great loss, but his pleasant and kindly personality, his teaching ability, and his keenness in research will never be forgotten.—SAMUEL VAN VALKENBURG

W. ELMER EKBLAW. W. Elmer Ekblaw, for many years professor of geography at Clark University and editor of *Economic Geography*, died at his home in North Grafton, Mass., on June 5. He was 67 years old.

Dr. Ekblaw began his professional career as a geologist, but his keen interest in the general field of the natural and social sciences soon led him into broader paths. He was an enthusiastic botanist, ornithologist, and archeologist, as well as a competent agricultural and human geographer.

From 1913 to 1917 he served as geologist and botanist of Donald B. MacMillan's Crocker Land Expedition. His experiences during these four years in the north generated a lifelong interest in Arctic problems, which is reflected in his writings; for example, "The Ecological Relations of the Polar Eskimo" (*Ecology*, Vol. 2, 1921, pp. 132–144), "The Material Response of the Polar Eskimo to Their Far Arctic Environment" (*Annals Assn. of Amer. Geogrs.*, Vol. 17, 1927, pp. 147–198, and Vol. 18, 1928, pp. 1–24), "Eskimo Dogs—Forgotten Heroes" (*Natural History*, Vol. 37, 1936, pp. 173–184), and "The Arctic Voyages and the Discoveries of DeHaven, Kane and Hall" (*Proc. Amer. Philos. Soc.*, Vol. 82, 1940, pp. 877–887).

His Swedish heritage inspired in him continuing concern with the Scandinavian lands and peoples, and in 1947, "for his work in promoting good relations between Sweden and the United States," he received the Order of the North Star from King Gustav. Several of his published articles deal with fiords and fiord economy.

In recent years Dr. Ekblaw's heavy teaching schedule, manifold editorial responsibilities, and active participation in community affairs left him little opportunity to write. His last published work was the chapter on "Foods for Defense" in "America at War: A Geographical Analysis," a symposium volume edited by Professor Samuel Van Valkenburg (New York, 1942). It is in the editorial field that he rendered enduring service to the geographical profession. From 1926, when he first joined the faculty at Clark, his was the guiding hand that saw more than 90 issues of *Economic Geography* through the press.

EDWARD HEAWOOD. Edward Heawood, emeritus librarian of the Royal Geographical Society and medalist of both the Royal and Scottish Geographical Societies, died on April 30, 1949. He was 85 years old.

Mr. Heawood succeeded Dr. H. R. Mill as librarian of the Royal Geographical Society in 1901. It was largely owing to his scholarly guidance during the 33 years of his administration that the Society's foreign and historical collections were built up and maintained at their high level of excellence.

He was an internationally recognized authority on the history of cartography; his "The

Map of the World on Mercator's Projection by Jodocus Hondius, Amsterdam, 1608" (1927) and "English County Maps in the Collection of the Royal Geographical Society" (1932) are important contributions. His extensive study of paper watermarks used in England was of great service in determining the dates of maps and other documents. Another of Mr. Heawood's fields of interest was the history of exploration. For many years he was treasurer of the Hakluyt Society. His "History of Geographical Discovery in the Seventeenth and Eighteenth Centuries," published in 1912, is still considered by competent authorities to be the best general study of exploration in that period. He contributed numerous notes and reviews, as well as longer papers, to the *Geographical Journal.*

GEOGRAPHICAL REVIEWS

THE SITUATION IN ASIA. By OWEN LATTIMORE. 244 pp.; index. Little, Brown & Co. (An Atlantic Monthly Press Book), Boston, 1949. $2.75. 7¾ x 5¼ inches.

As this review is written, the Department of State has just released the voluminous White Paper on China. Without venturing into debate on its contents, it may surely be agreed that the very bulk of the volume will discourage most readers, however interested they may be, from any careful perusal and study. If one's knowledge of the frustrating dilemma in which America finds herself in the Far East is confined to summaries of the White Paper and editorials and comments on it, it is all too probable that initial confusion will be thrice confounded. A realistic, hardheaded survey of the elements of the situation in Asia is most urgently needed, free of official apologia and devoid of special pleading. Lattimore's book is such a survey, served up in highly readable form and possessing the rare merit of brevity.

Lattimore attempts to view the postwar economic, social, and political picture of Asia as a whole, striving for an intelligent perspective. The problem of China, approached in this fashion, naturally acquires far more meaning than if it had been considered in the present conventional style as a problem in itself, which may affect other areas but is not affected by them. It is to be hoped, indeed, that such a method will be followed by those who are now charged by our government with the duty of working out a "new" policy for America in Asia.

There are several basic premises in this broad survey about which there has been, inevitably, marked disagreement among the "experts." Wholly valid or not (and to this reviewer they are more valid than questionable), they are thought-provoking. The author begins by stating unequivocally a fact which it is hard indeed for Westerners to digest: in any future relations, we of the West must negotiate with the *peoples* of Asia, and the success of any such negotiation will depend upon our demonstrated ability to provide the peoples of Asia with what they desire. Later in the book this basic tenet is necessarily modified: there must be, on our part, not only a demonstrated ability to supply Asiatic wants, but that ability must be demonstrably superior to that of other interested nations. In other words, in the struggle for influence in Asia now under way between Western countries, led by the United States on the one hand and Soviet Russia on the other, it is imperative that we first comprehend realistically the desires and needs of Asia and then, out of the strained plenty of our resources of all kinds, satisfy those needs more effectively than the Soviets can.

Asia, says Lattimore, is today clearly "out of control." This is, of course, hardly a startlingly new statement. But what conclusion regarding the future is to be drawn from it? To many it appears that the power politics of the Asian area can be explained today as a new version of extra-Asian powers struggling for control of the continent and outlying island groups. To those supporting such a view, the only question to be solved in the power struggle is whether America and its allies or Soviet Russia will be the new controlling element. Lattimore sharply contradicts this point of view. The new forces, the "third countries" in the area as a whole, will, in his opinion, possess such weight that they both can and will render any clear-cut American or Russian "victory" impossible. By a well-coordinated program of supplying the needs of those countries it might be possible for the United States and its friends to develop an Asia strong enough to resist attempted control by Russia.

The book does not enter into detail as to ways and means. Those who impatiently

demand a blueprint (often, it seems, to be in a better position to embark on a course of enervating criticism) will not find it here. Those who prefer to have a clear background of basic elements upon which programs can be formulated will find much grist for their mill. "Point Four" and possible development programs under United Nations aegis come to mind and, indeed, are delicately suggested by Lattimore. Capital equipment, an "agricultural revolution," exploitation of undeveloped resources, adequate transportation facilities, technological education—all of these must figure prominently in any list of Asiatic needs. Is it not wholly likely that it is in the United States, rather than in Russia, that exportable surpluses adequate to satisfy, or at least whet, Asiatic appetities are to be found?

If so, the author has a further warning. The time is past when the United States can extort a political or ideological *quid pro quo* for material assistance. We must prove the superior merits of our political and ideological systems by the fruits thereof. If we do not possess transcendent confidence in our ability to prove them to the complete satisfaction of any people anywhere—then the cancer is already deep within us.—William G. Fletcher

FRONTIER LAND SYSTEMS IN SOUTHERNMOST CHINA: A Comparative Study of Agrarian Problems and Social Organization among the Pai Yi People of Yunnan and the Kamba People of Sikang. By Chen Han-seng. vii and 156 pp. (mimeographed). International Secretariat, Institute of Pacific Relations, New York, 1949. $2.00 10¾ x 7¾ inches.

Of such variety does this study of two fascinating and relatively unknown regions of China consist that its subject matter is of concern alike to geographers, anthropologists, sociologists, political scientists, economists, and historians. The title, however, would be more accurate if the term "southernmost" were changed to "southwestern"; for the second of the areas compared lies on about the same latitude as Shanghai in "Central China."

The basis for comparing these two rather different groups of people seems to be that both have relict feudal or semifeudal land and social systems, both lie in frontier zones, and both suffer from the same superimposed Chinese administrative system, which, while continuing the feudal and hereditary native officialdom, lays yet another burden upon an already wretched indigenous population.

The importance of the Pai Yi of southernmost Yunnan lies in the fact that they are members of a language group of Yi tribespeoples numbering about 20 million in continental Southeast Asia, of whom some seven million are in China's four southern provinces. The Kam-ba are Tibetans living in Sikang, northern Yunnan, and northwestern Szechwan. They outnumber their brethren in Tsang or Tibet proper two to one but even with them reach a total of only about three million.

In southern Yunnan, Pai Yi landownership is that of a prefeudal society, being common and collective The nature of the village is strikingly revealed in such matters as tribute payment and land tenancy. Geographical isolation, restricted development of commercial crops, and a sparse population have been the chief factors in preserving the remnants of a primitive commune. Low productivity and inadequate means of production such as poor plows and lack of work animals explain why a quarter of the arable land has never been cultivated. Trade and usury, twin forms of Chinese economic penetration, together with the harsh tribute and rent exactions are working for a disintegration of this protofeudal society.

In geographically well-secluded Kam-tsang or "Tibetia," social-economic structure has remained largely unchanged since as early as 1270 and the Yuan dynasty. The region has never been effectively conquered by the Chinese, and the principal economic tie between them and the Tibetan peoples has been the tea trade. The usury relationship that developed between the monopolistic Chinese tea merchants and the Tibetan chieftains and lamas made the Kam-ba ruling families increasingly dependent on the Chinese tea trade. It was the British penetration of Tibet proper from India and the threat to the tea monopoly that brought about the lopping off of eastern "Tibetia" to form the new province of Sikang from 1905 on. Although the hereditary feudal Tu-ssu or chieftain now has no legal status, he still exercises real power in the province.

During the twentieth century the policy of the Chinese government has been applied toward undermining local authority and encouraging the deconcentration of landownership by confiscation of land, nationalization of land, and colonization of land by Chinese settlers. Little has been accomplished. *Ula*, or the forced labor system, is still the dominant and controlling factor in the feudalistic structure of Sikang. The remedy for this diseased society, according to the author, calls for the abolition of the ula system and the legal fixing of landownership, the development of labor cooperatives to alleviate the disadvantages of small-scale farming, and the granting of self-determination for the development of democratic local government.—HEROLD J. WIENS

THE NEW ATLAS OF CHINA of Ting Wen-chang, Ong Wen-hao, and Ts'eng Shih-ying. Postwar revision, 5th edit. By TS'ENG SHIH-YING and FANG CHÜN. 58 pp. of maps; 94 pp. of Index and Guide Lists. *The Shen Pao,* Shanghai, 1948. 10½ x 7½ inches. (In Chinese.)

This revision of the famous "V. K. Ting" Atlas of China fills a real need both in China and abroad. In several respects it is an improvement over the first edition (1934). The map of climatic types, by A. Lu of the Central Weather Bureau, is a reclassification of Köppen and a further refinement of Tu (see A. Lu: The Climatic Provinces of China, *Journ. Geogr. Soc. of China,* Vol. 12–13, 1945–1946, pp. 15–24). Smaller maps show fog, cloudiness, humidity, temperature extremes, winds and pressures, and rainfall.

The soils map, from the Soils Research Section of the National Geological Survey, is a new feature. It is both a refinement and an extension of Thorp's study of 1936. The soils of all China, including Taiwan, are divided into 13 groups covering 32 types. Thorp's Shantung Brownsoils now extend to the far west as brown clays—in patches in Honan, southern Shensi, northern Szechwan, and north of Hankow. Thorp's red soils along the east and south China coasts are interspersed with humid and alluvial soils and gray-brown earths. Most important is the mapping of desert soils in the north and northwest. The Atlas shows the area south of the Yellow River bend as light pedocals, so that true desert soils (including Browns, Grays, and Sand Dunes) are farther west and, in Ninghsia for example, much more restricted than before. The new mapping to the farthest limits of the north and west is an illuminating advance, though probably not yet final. The reviewer believes that geographers outside China would heartily welcome the publication and explanation in Western journals of the climatic and soils maps, and also the map of mineral deposits, not only for their new information, but also—and particularly in the case of the soils map—to provide a technical vocabulary for common reference.

The 12 plates of crop production in the original are regrettably omitted, nor is there a map of natural vegetation.

The first edition divided the country into 22 sheets at 1:2,000,000 and printed each sheet twice, showing political and relief features separately. More conveniently, the fifth edition carries one province on a page or two adjoining provinces on facing pages, so that the full shape of each province is seen at once. Scale has necessarily been reduced to 1:3,000,000 for most of the provinces, to 1:5,000,000 for Ch'inghai, Hsitsang (Farther Tibet), and Heilungkiang-Hsingan-Nunkiang, and to 1:7,500,000 for Sinkiang and Mongolia.

The Index to Place Names is shorter and locates places by map coordinates rather than by geographical coordinates, though on the provincial maps both must be used. The method is explained and diagramed in the Index.

As a measure of development in China the map of important mineral deposits is notable, not only for its revised coal and iron estimates, but even more for the record of new discoveries. Comparison with the first edition reveals the great increase in knowledge of resources in western Sinkiang and Tibet, and also in Yunnan and Kweichow. Much of this increased knowledge comes, of course, from the work of one of the original compilers, Dr. Ong Wen-hao, for many years director of the National Geological Survey, and his colleagues and students.

Another interesting development is in railroads, more correctly shown on the overall map of political divisions than on the provincial maps. It should be understood that the railroads represent the extent of maximum construction rather than of present operation, both those in the civil-war zones and those in other parts of the country. The projected lines that appear will be of real interest.

Political changes are incorporated. Taiwan is part of China, and new names of cities are given. Manchuria is divided (late 1945) into nine provinces instead of the former three. On the map of Mongolia a note explains that as of January, 1946, the Chinese government informed the "K'u Lun government," i.e. at Ulan Bator, that independence was granted; however, boundaries remained to be settled. This area is now the Mongolian People's Republic (Outer Mongolia).

As a whole, the Atlas is carefully done. It is a useful and worth-while descendant of excellent ancestors.—THEODORE HERMAN

THE CHINESE IN MALAYA. By VICTOR PURCELL. xvi and 327 pp.; maps, bibliogr., index. Issued under the joint auspices of the Royal Institute of International Affairs and the Institute of Pacific Relations. Oxford University Press, London, New York, Toronto, 1948. \$6.00. 8¾ x 5½ inches.

For centuries Chinese from the two southern provinces of Kwangtung and Fukien have migrated south to Nan Yang, or Southeast Asia. Malaya takes a special position among the countries around the South China Sea in that it not only has the largest absolute number of Chinese but its Chinese residents actually outnumber the native-born Malays.

The postwar development of China and Malaya has made it important for us to have a clear understanding of the history of the Chinese in Malaya, of their role in the modern economic and political life of that country, and of the ties between the Chinese community in Malaya and the mother country. Mr. Purcell's scholarly study is therefore most timely; and it should be pointed out that he had excellent qualifications for undertaking it, since the

various positions that he held in Malaya over the course of several decades brought him into daily contact with the Chinese in an official capacity.

The book is divided into three parts. The first deals with the history of the Chinese in Malaya up to the end of the nineteenth century. The second is a rich mine of information regarding special aspects of the life of the Chinese community—such as secret societies, social problems, labor, education and religion, political societies—and the place of the Chinese in the economy of Malaya. The third treats briefly the period from 1939 to 1946 and describes the war and postwar problems of the Chinese community. Statistical data are presented in appendixes.

Geographers will find the second part especially valuable. One drawback might be noted. The book is based on observations made across an official desk in Singapore and not on observations gained through field contact with Chinese in mines, plantations, agricultural or fishing communities, or small trading settlements. One does not get an insight into the contributions of the Chinese to the cultural landscape of Malaya. The chapter on social problems deals with such dark aspects as opium trade and traffic in women and girls, but one looks in vain for a treatment of Chinese family life in Malaya or of social relations between Chinese and Malays or other ethnic groups. A chapter apiece is devoted to secret and political societies, but a treatment of clans and their role in the life of Chinese in Malaya is lacking.

Mr. Purcell shares the view held by Sir Frank Swettenham that the Chinese are the builders of modern Malaya. Sir Frank wrote years ago: "Their energy and enterprise have made the Malay States what they are to-day, and it would be impossible to overstate the obligations which the Malay Government and people are under to these hard-working, capable, and law-abiding aliens." Mr. Purcell shows that the Chinese are by now deeply rooted in the Malayan soil and that they "have come to stay."—KARL J. PELZER

NEW WORLDS EMERGING. By EARL PARKER HANSON. xiv and 385 pp.; index. Duell, Sloan & Pearce, Inc., New York, 1949. \$3.50. 8½ x 5¾ inches.

The keynote to this book is struck by the quotation which appears on the title page: "There is no land unhabitable, nor sea unnavigable." It is taken from a letter written by an English merchant, one Robert Thorne, for transmission to King Henry VIII in 1527. More than four centuries later Professor Hanson, now chairman of the Department of Geography of the University of Delaware, after many years of wandering in the remoter parts of the world uses the same words to express his own belief. In particular he urges the vast possibilities of the Amazon Basin ("as varied as the United States, and possibly as rich in the quantity and variety of its natural resources"), tropical Africa, and the northern lands of Alaska ("our vast, wealthy, and beautiful empty empire") and Iceland ("one of the most progressive countries on earth").

It is unfortunate that both author and publisher should regard the book as "an exciting challenge to modern pessimism . . . a profound stimulus upon a world too much discouraged by such works as Osborn's *Our Plundered Planet* and Vogt's *Road to Survival*." In many ways Hanson's book closely resembles Vogt's. Because Vogt brought to a wide public the seriousness of the scourge of soil erosion which threatens to extinguish mankind, he may perhaps be forgiven his lack of accuracy, his sacrifice of truth to the telling phrase, and his journalistic language. Hanson has these same faults: the serious reader will find himself questioning the accuracy of so many statements that he will make a mental reservation against all. Unhappily

the author makes it difficult to check his statements and quotations. He quotes writers without giving more than a bare clue to the century or circumstances in which they wrote. In arguing his case for the Amazon, he appears to accept literally De Carvajal's account of large settlements, gleaming white houses, orderly streets, plazas and temples, reputedly seen by Orellana in 1541–1542. Similarly, one would like to distinguish between what Hanson actually saw and mere hearsay, just as one would prefer to read what Thorne or Humphrey Gilbert actually wrote rather than a translation "into twentieth century English."

There is now sound evidence from many sources, experimental and observational, that the physiological effects of climates formerly regarded as "unhealthy" are not unfavorable to human development. We may acknowledge that manual work and exercise in the humid tropics are beneficial, that it is the sociological or psychological effect on the white man which needs investigation, but it is surely destroying a good case to pretend that such scourges as yellow fever, malaria, and, presumably, typhus are merely the results of malnutrition. While attention is very properly called to valuable native agricultural techniques, Hanson does not draw the obvious conclusion that the profligate Western nations must learn therefrom. Instead, we find in the epilogue that he pins his faith on the same capitalist free enterprise the results of which he has so wholeheartedly condemned in the preceding pages. The great fear is that Hanson's new worlds may emerge before Vogt's road to survival has been followed.—L. DUDLEY STAMP

DEMOGRAPHIC SURVEY OF THE BRITISH COLONIAL EMPIRE. Volume 1, West Africa. By R. R. KUCZYNSKI. xiii and 821 pp.; bibliogr., index. Issued under the auspices of the Royal Institute of International Affairs. Oxford University Press, London, New York, Toronto, 1948. $21.00. 9¾ x 6¼ inches.

The student of British West Africa will find this first volume of Kuczynski's remarkable "Demographic Survey of the British Colonial Empire" packed with detailed information not readily available elsewhere. The demographer, however, will accept the book with reservations: as a statistical study it admittedly suffers from the inadequacy of census figures that are "reasoned guesses" instead of facts.

The tentativeness of Kuczynski's conclusions is illustrated by the large margin of error he allows for in his population estimates. He believes that in 1940 the native population of the four British dependencies in West Africa (the proportion of non-natives is "negligible") totaled between 24,500,000 and 29,000,000. The 1931 total was "probably" between 23,300,000 and 27,400,000. Kuczynski found no evidence that the population of the Gambia had increased either before or after 1920. In Sierra Leone the population of the Colony (Freetown and vicinity) has increased through immigration; the Northern Province has "apparently grown through natural increase." The author believes that the population of the Gold Coast (including British Togoland) has grown since 1920, partly through natural increase and partly through immigration, but he doubts whether it was increasing before 1920. As for Nigeria (including British Cameroons), the population has increased slowly during the twentieth century. The early estimates for Northern Nigeria were "grossly exaggerated," Kuczynski writes, and its population "probably did not increase in the first 25 years of British administration. From 1926 to 1940 it apparently grew somewhat, but it seems unlikely that the increase exceeded 10 per cent." In Southern Nigeria the population "apparently increased

considerably" through immigration in the latter part of the nineteenth century and "is now probably a little larger than at the beginning of this century."

Registration of births and deaths is compulsory for only about 9 per cent of the population in the Gold Coast, 7 per cent in the Gambia, 6 per cent in Sierra Leone, and 1 per cent in Nigeria. The resulting inadequacy of current vital statistics may partly explain why the author goes into such detail in tracing the history of demography in British West Africa. This historical approach leads him to give 289 pages to Sierra Leone, which has only two million people but in which the first census was taken in 1802, whereas Nigeria, with 21 million people, receives only 233 pages, since census-taking did not begin until 1866.

Kuczynski presents many interesting facts about the medical history of a land that acquired a reputation as the "White Man's Grave." Although based on a mixture of fact and fancy, this reputation was partly deserved. From 1881 to 1897 the average death rate of European officials in the Gold Coast was 76 per 1000; today the death rate of the European community is less than 10 per 1000. Such figures are unavailable for the African peoples. As Kuczynski remarks, the appraisal of "fertility, morbidity, mortality, or migrations is about as difficult" in most African dependencies as the appraisal of the "frequency of adultery" in the United Kingdom.

One interesting but unhappy fact pointed out is that the two World Wars and the great depression resulted in the reduction of trained medical personnel in British West Africa. At the outbreak of World War II the ratio of medical officers to population was smaller than it had been 25 years before. The reduced medical staffs have had to be concentrated in newly developed mining and other labor centers, "where an ever-increasing number of ill-nourished natives are exposed to infection and to physical exhaustion." Furthermore, laborers returning from these new work centers spread diseases in their home villages. However, Kuczynski finds "no conclusive proof that morbidity and mortality have increased."

The study is abundantly annotated and full of direct quotations from many sources otherwise difficult to find. Some readers, however, may question the author's practice of presenting at such length, often in quotation, evidence of limited value from inexperienced observers. Nonetheless, the book is certain to remain the standard reference work on the historical aspects of the subject, even though future statistical information may modify some of the conclusions. It should also serve a useful purpose in helping colonial officials to avoid some of the pitfalls in census taking.—VERNON McKAY

COLONIAL POLICY AND PRACTICE: A Comparative Study of Burma and Netherlands India. By J. S. FURNIVALL. xiii and 568 pp.; map, bibliogr., index. Issued in co-operation with the International Secretariat, Institute of Pacific Relations. At the University Press, Cambridge, 1948. 36s. 8¾ x 5½ inches.

This volume, De Kat Angelino's "Colonial Policy," and Lord Hailey's "African Survey" form a triad everyone interested in the problems of dependent areas should read. De Kat Angelino emphasized the ideals, the synthesis of cultures; Hailey stressed practical problems of welfare; and Furnivall points up the disparity between doctrine and practice. Some sentences from the preface explain the origin and purpose of his study:

"This book originated in a request from the Government of Burma at the end of 1942 for my views on reconstruction, with particular reference to features of colonial rule in

Netherlands India that might suitably be adopted in Burma. . . . I suggested that [certain notorious evils of modern Burma] . . . can all be traced to a common cause: the disintegration of social life through the inadequacy of law to control the working of anti-social economic forces. Although in other respects Dutch rule is open to criticism which does not apply to Burma, yet in all these matters Netherlands India presents a notable contrast."

These differences, as well as the fundamental similarities inherent in the colonial relationship, are the laboratory ingredients for Furnivall's investigation. Furthermore, he has drawn upon African materials for additional evidence. It is to be regretted that he makes no comparisons with tropical America. One can understand that British, French, and Dutch colonial experts are loath to go beyond the areas with which they are most familiar. Yet because of this they have denied themselves fertile fields of comparison. Here is one of the weaknesses of regional specialization. Admittedly, a course of events cannot be divorced from its local environment, but a study of present and former dependencies in the American tropics would suggest other solutions—or disillusionments.

The fundamental reason, according to Furnivall, why even the most humanitarian colonial policy has failed is that the native peoples themselves lack the will toward progress. Is this an inherent trait of race or culture? Furnivall does not think so. He believes that nationalism, "a destructive fever" under colonial rule, can be transformed into "a creative force" by independence, resulting in a self-propelled drive toward social welfare. One can only hope that the future will prove him right. The alternative is anarchy, with the chance that another external force will move into the power vacuum. Again, tropical America might suggest other possibilities.

Aside from questions of colonial policy and practice, Furnivall's detailed account of Burma's social and economic history since the early nineteenth century deserves special mention (Chapters 2 to 6). He deals with the Indies more briefly, but reference should be made here to his excellent treatise on this region, "Netherlands India" (Cambridge University Press, 1939). The bibliography is fairly satisfactory, though it is conspicuously incomplete on recent American publications. Trade figures are given in appendixes, and there is a sketch map of Burma.—JAN O. M. BROEK

AGRO-ECONOMIC SURVEY OF THE UNION [OF SOUTH AFRICA]. *Econ. Ser. No. 34, Bull. No. 270,* Division of Economics and Markets, Dept. of Agriculture, Pretoria, 1948. 1s. 9½ x 6 inches.

Since 1937 the Division of Economics and Markets in the Union has had officers in all parts of the country collecting information and statistics on which to base this survey. The present bulletin, which is the first detailed report issued, discusses the factors on which the regional classification has been based and analyzes the agronomic conditions in the region styled "The Dryland Farming Areas of the Inland Plateau."

The major factors taken into consideration in the survey are: (*a*) physical—topography, soil, and climate, especially rainfall; (*b*) economic, including marketing, transport facilities, prices, and comparative costs; (*c*) biological, particularly diseases and pests; and (*d*) historical, i.e. established practices.

An agro-economic area is taken to be a portion of the country which, on the basis of these four groups of factors, "is more or less homogeneous, and where, consequently, a characteristic system of farming has been developed." The boundaries between such areas

have generally been fixed "where the influence exercised by one or more factors on farming showed a considerable increase or decrease, causing a change in the nature of the region and consequently in the farming system practised there." But it is made quite clear that boundaries must often be only approximate indications of the zones where one region merges into another. Each of the four groups of factors is discussed in detail, with illuminating references to particular occurrences within the Union.

This report deals with the areas in the southern Transvaal and northern Orange Free State producing crops without irrigation—the sense in which "Dryland Farming" is used in this description. The term "Inland Plateau" appears to be limited in its application to the northeastern part of what, to geographers, is the physiographic High Veld Region of the South African Plateau. The region, subdivided into six areas, is described in terms of the four basic factors mentioned above, and numerous tables are given showing proportions of land devoted to various purposes, capital investment, sources of cash income, labor, burden of debt, and the problems with which farmers are immediately confronted.

On the economic side the report gives largely prewar values and is thus already somewhat out of date, but, as the authors point out, the basic factors of the environment do not change. "Economic factors may lead to changes in the farming system, but this can take place only within the limits set by natural conditions."

Accompanying the report are five maps of the Union showing agro-economic regions, rainfall, soil groups, vegetation, and native areas.

This bulletin covers an area of some 31,000 square miles, which is about one-fifteenth of the total area of the Union. The rest of the country will be dealt with in subsequent publications.—J. H. WELLINGTON

LA CIVILISATION DU DÉSERT: Nomades d'Orient et d'Afrique. By ROBERT MONTAGNE. 270 pp.; maps, ills., bibliogr. (Le Tour du Monde.) Hachette, Paris, 1947. 210 fr. 8 x 5¼ inches.

MISSION SCIENTIFIQUE DU FEZZÂN (1944–1945), III: GÉOGRAPHIE HUMAINE. By J. DESPOIS. 268 pp.; maps, ills., bibliogr. (Publications de l'Institut de Recherches Sahariennes de l'Université d'Alger.) P. Lechevalier, Paris, 1946. 9¾ x 6½ inches.

The Sahara and Arabian Deserts used to be considered a harmonious combination of two modes of life: that of the nomads and that of the sedentary inhabitants of the oases. The harmony seems to have been greatly idealized: it was broken long ago. A steady decay has set in. The quick rhythm of the present period gives a sharp edge to many problems. They are illustrated in these two books, one of which analyzes the mode of life of the nomadic Bedouins and the other presents results of a field study of the human and economic geography of a group of oases in the southwestern section of what was, before the war, Italian Libya.

Professor Montagne of the Collège de France describes the general pattern of nomadic life in the Arabian and Sahara Deserts but devotes most of his attention to the Syrian Desert, which he knows best. It is a well-documented picture of a civilization that is indeed adapted to the physical environment: the standard of living is as low as the average rainfall. Chapter 2, describing the social organization, is of special interest, but the reader would like more stress on the similarities of today's life with that of Biblical times; Professor Théodore Monod has tried to give such a parallel for the Bedouins of the western Sahara in his "Méharées." After a sketch of the spiritual life, literature, legends, and beliefs of the nomads and the politi-

cal geography of scattered groups ruled by emirs (with the exception of the large kingdom of Saudieh), Montagne comes to the great trend of change, the trend toward sedentarization. Chapter 7 is perhaps the most original of the volume, and the most interesting to the geographer: driven into unbearable conditions by the surrounding advance of Western civilization, the nomad is forced to settle down in a smaller area, even to cultivate a patch of land. His camel, that essential tool and symbol of nomad civilization, is being slowly outmoded by the automobile and, even more, the airplane. The change of techniques in transportation will be decisive for the ever-moving people.

In the midst of the Sahara, Professor Despois has found a startling problem. The Fezzan group of oases is one of the best endowed by nature in the great desertic area, yet it displays an impressive array of ruins. The population once was denser, the prosperity far greater, particularly before the twelfth century. Some have tried to explain the decay of local agriculture on social grounds, notably the abolition of slavery, but decadence had set in long before the slaves were freed. Now the capital of the Fezzan, Murzuk, is a typical caravan city, but what a meager caravan trade it has today! Circum-African navigation, then the automobile and the plane, have replaced the old caravans; more important perhaps, political changes and new boundaries have cut off the Fezzan from the markets with which it used to trade. New routes were established across the desert that passed elsewhere; the oases remained a crossroads, but chiefly for invasions. Nowadays the main problem is agricultural: much improvement could be effected by modernization of techniques, especially of obtaining underground water. Since 1943, under French military occupation, the Fezzan has again had greater contact with the areas of the French Sahara to the west and south with which it has more natural links. It has gained also by the lowering of the barrier that separated it from Algeria and Tunisia. Despois's book is a model of its kind, a bright and thorough study of the regional problem arising out of the isolation of a small group of people in empty country.—JEAN GOTTMANN

POLLEN DIAGRAMS FROM LABRADOR. By CARL-GÖSTA WENNER. Maps, diagrs., ills., bibliogr. *Geografiska Annaler,* Vol. 29, 1947, pp. 137-374.

This is a cogent and comprehensive interpretation of pollen profiles from peat bogs along the coast of Newfoundland-Labrador. The interpretation from pollen profiles in other parts of the Northern Hemisphere of climatic trends and their correlation with postglacial climate receive support from the interpretation of peat stratigraphy. Correlation of strand lines of the Labrador coast, though they are somewhat hypothetical, with those of the Baltic gives further support to climatic interpretations.

The area covered by pollen analysis reaches from St. Anthony, near the northern tip of Newfoundland, to the Kaumajet Mountains, on the Labrador coast at about 58° latitude, a distance of some 750 miles. Peat sections were taken in the three vegetation zones—the Boreal forest, the tundra or barrens, and a transition zone of low, shrubby conifers, alder, and willow. The bogs or swamps are described as of two chief types: the basin swamps formed in ponds apparently by normal succession, and paludification swamps built up on generally flat terrain or on old bog surfaces of filled-up lakes. "Paludification" swamps, a term originated by Von Post, apparently are the equivalent of the muskeg formed on flat terrain over much of the tundra of North America. A peculiar type of peat deposit is described, on which mounds of sphagnum a meter or more in thickness occur. These mounds, also known as "palsas," lie

directly upon mineral soil and remain frozen throughout the summer. Similar bog structures are common in northern Europe and are attributed to successive freezing downward in the peat mound, which, by drawing up water from below, results in the formation of an ice mound. Recent invasion of heath and willow on the flat sphagnum bogs is interpreted as a response to a drying climate. In Labrador this theory is consistent with the climatic records, which reveal that the annual mean temperature has been rising, and humidity decreasing, during the past 50 years at least.

TENTATIVE SCHEMATIC REVIEW OF POSTGLACIAL TIME IN NEWFOUNDLAND-LABRADOR AND OTHER AREAS

NORTH-EASTERN U. S. A. (SEARS AND OTHERS)	SOUTH-EASTERN CANADA (AUER)	SOUTHERN LABRADOR (BOWMAN)	NEWFOUND-LAND-LABRADOR	SOUTHERN SWEDEN (SERNANDER)	RECURRENCE LEVELS (GRANLUND)	
Climatic deterioration	Subatlantic time		Increased paludification (and revertence of tundra pollen)	Subatlantic time	I	1200 A.D.
					II	400 A.D.
					III	600 B.C.
Xerothermic phase (high pollen percentage of Acer etc.)	Subboreal time (high pollen percentage of Tsuga etc.)	(pollen of Acer and Tsuga)	Conifer forest at its height	Subboreal time	IV	1200 B.C.
					V	2300 B.C.
	Atlantic time		Subarctic alder forest	Atlantic time		

A study of pollen and spore types found in the peat is presented. Pollen and spore types that could be identified as to fimily or genus were of some 60 kinds, including six fairly common arboreal species and eight of more sporadic occurrence. Some 30 kinds of non-arboreal pollen were identified. Exhaustive experiments were made to determine the relative effects of various methods of treatment of the peat for pollen analysis. The results of these experiments and of statistical studies are valuable in that they reveal the many variables and possible sources of errors in pollen statistics.

The postglacial vegetation is interpreted separately for the southern or forested region and the northern region, where many of the sections were obtained from the tundra. When the glacier retreated from southern Newfoundland-Labrador, the tundra was invaded by birch and alder. As the climate became warmer and drier, these were gradually replaced by spruce and fir, and birch and alder occupied transition areas between the tundra and the conifer forest. Since the maximum expansion of the conifer forest, extensive paludification has occurred, suggesting a moister and cooler climate. In the northern region, the pollen diagrams are less definite but in general record a zone of alder and birch, with revertence to tundra at certain levels. The climatic deterioration since the maximum of the conifer forest indicated in the southern peat sections is better defined in the northern part of the forest region where it is contiguous to the tundra. Here the climatic maximum as recorded in the stratigraphy of the sedimentary columns seems to be chronologically correlative with maximum forest development as well as with less well defined invasion of alder on the tundra.

The climatic trend suggested by the pollen profiles receives some support from sequences

of peat strata, which reveal alternating dry and wet periods. In the southern part of the region there are one or more earlier heath layers in the bogs; the greatest number is five. In view of the fact that a warmer and drier climate during the past 50–75 years has favored heath vegetation and decomposition or humic development on bogs, these heath layers formed in the past are considered to represent warm, dry intervals. Heath layer III is the most prevalent and the best developed and occurs in both northern and southern Newfoundland-Labrador, where it usually lies near the middle of the organic sedimentary column. Above layer III extensive paludification or resumption of peat formation is evident. This denotes climatic deterioration, which is corroborated by tundra or expansion. Other heath layers are correlated chronologically with Granlund's recurrence levels in bogs of southern Sweden and are thought to represent similar climatic trends. They are also correlated chronologically and climatically with the Blytt-Sernander scheme of southern Sweden, with heath layer III equivalent to the end of the warm, dry Subboreal period, about 600 B.C. Heath layer IV is correlated with recurrence level IV in southern Sweden at about 1200 B.C., or midway through the Subboreal stage. A discussion and table (p. 295) show chronological correlation of the warm, dry maximum in Labrador with Sears's xerothermic phase of the northeastern United States and the climatic maximum interpreted by Auer from pollen profiles in southeastern Canada and by Bowman in southern Labrador.

In a correlation with the strand lines of the Baltic basin the oldest pollen-bearing sections are dated as younger than the Finiglacial time of De Geer and Lidén's chronology and the Boreal time of the Blytt-Sernander scheme, which would make them less than 6000 years old. During the warm, dry maximum, sea level along the Labrador coast was lowered as much as 20 meters; other strand lines are attributed to processes that are largely in agreement with the views of Daly and Ramsay.

This monograph, with its consideration of methods, statistics, and climatic and chronologic interpretations, is a valuable contribution to the accumulating data on postglacial vegetation, climate, and chronology in eastern North America and Europe.—HENRY P. HANSEN

THE TOWN OF MAIDEN CASTLE. By ERIC BENFIELD. 70 pp.; map, ills. Robert Hale Limited, London, 1947. 7s. 6d. 8¾ x 5½ inches.

MERLIN'S ISLAND: Essays on Britain in the Dark Ages. By T. C. LETHBRIDGE. xi and 188 pp.; maps, ills., index. Methuen & Co. Ltd., London, 1948. 10s. 6d. 7½ x 5 inches.

ROMAN LONDON: A.D. 43–457. By GORDON HOME. 3rd edit. xii and 13–302 pp.; maps, ills., bibliogr., index. Eyre & Spottiswoode, London, 1948. 18s. 8¾ x 5½ inches.

ROMAN WAYS IN THE WEALD. By I. C. MARGARY. 2nd (revised) impression. 287 pp.; maps, diagrs., ills., bibliogr., index. Phoenix House, London, 1949. 25s. 8¾ x 5½ inches.

TOPOGRAPHY OF ROMAN SCOTLAND: North of the Antonine Wall. By O. G. S. CRAWFORD. xii and 162 pp.; maps, ills., index. At the University Press, Cambridge, 1949. 10 x 7¼ inches.

PREHISTORIC BRITAIN. By JACQUETTA AND CHRISTOPHER HAWKES. xvi and 280 pp.; diagrs., ills., bibliogr., index. Chatto & Windus, London, 1948 (1947; 2nd impression 1948). 15s. 8¼ x 5¼ inches.

These six books on ancient Britain illustrate the current interest in questions of origins and

at the same time provide a fair sample of the various approaches to the subject. The geographer will find much common ground in the subjects the authors handle and in the tools of their research. The emphasis on field work and map study gives him an obvious point of contact and an opportunity of contributing to this branch of knowledge. Nor is prehistory irrelevant to his own studies. The growing interest in origins is not a flight from the problems of the present; on the contrary, it reflects a desire to trace the patterns of culture from the dim beginnings down to the complexities of modern life. To take one practical example: the important subject of field systems and rural settlements has been notably advanced by the contributions of archeology. Above all, these books remind us of the variety of cultures, in time and space, that have contributed to the greatness of a small country.

Frankly popular in its appeal and unreliable in its facts, Eric Benfield's "The Town of Maiden Castle" can be briefly dismissed. Not so its subject. Readers of Thomas Hardy's Wessex novels will recall his imaginative descriptions of this great earthwork on the Purbeck downs, precursor of the Roman Dorchester. Maiden Castle was excavated by Dr. R. E. M. Wheeler in the early thirties for the Society of Antiquaries of London and was shown to have been first occupied in the Neolithic period, reoccupied in Celtic times, and progressively enlarged and refortified until it was abandoned in Roman times. In these respects it is merely the most magnificent of many such earthworks of the southern chalklands.

Dr. Wheeler and the Research Committee are not likely to feel grateful for the use that has been made of their labors. To describe Maiden Castle as a "town" is not the right way to "wipe out the facile idea that Rome discovered our fathers to be painted savages without civilization of any kind." There is all the difference in the world between a work of popularization written by a specialist and a work about specialist researches written by a popularizer. The cause of truth is badly served by theories of "water-animal men," noble savages, and pure races, of large populations living in cave dwellings that are now known to have been storage pits. The photographs, taken from the official report, are admirable, but the author's sketches are useless. There is a genuine popular appetite for prehistory, and it deserves to be nourished on better fare. It is interesting to observe in passing that the present-day emotional attraction of the pre-Saxon and pre-Roman phases of British life appears to be in part a reaction against the modern manifestations of the Rome-Berlin axis.

It is difficult to classify T. C. Lethbridge's "Merlin's Island," described as "essays on Britain in the Dark Ages." The work of an experienced and qualified field archeologist who is, however, not without his prejudices, this little book has many qualities and many defects. It is well named for a master magician: its ideas are wooly, its theories often contradictory. Mr. Lethbridge is both a student with scholarly interests and a practical man who stands no nonsense and delights in knocking down idols such as Anglo-Saxon superiority. His book is a similar mixture. It is full of stimulating thoughts that throw new light on old subjects, yet the writing is labored and difficult. The author strides back and forth across the centuries in a fascinating but often bewildering way. The topics discussed are: Archaeology and the Souvenirs of War; Roman Britain Changes into Saxon England; Houses, Boats, and Early Voyages to America; The Western People and the Saxons; Kent and the Education of the Barbarians; Trading Ventures of the Dark Ages. Mr. Lethbridge knows a good deal about boats and, having worked in Greenland and Iceland as well as in Britain, has a right to speak on early navigation in the North Atlantic. He believes that the Vikings in their voyages to Greenland and the North American mainland were merely following in the tracks of Irish missionaries bent on conversion. And "it must have been the Celtic leaven in the Norse

lump which led to the outburst of Saga literature in Iceland." There is considerable theorizing on boat types, including the kayak, umiak, dory, curragh, coble, dinghy, and lugger. Lethbridge has collected a good deal of evidence that seems to support his theories, but he has overlooked the Thule Eskimo harpoon from Ireland which the present writer published four or five years ago in the *Ulster Journal of Archaeology*. So much scorn has been poured on the Welsh Indians that one would rejoice in seeing the Irish Indians reinstated in their place, even if it would be asserted in some quarters that New England should have been New Ireland from the start.

Mr. Lethbridge also has novel views on the survival of Roman culture in Britain, and on the character and progress of the Anglo-Saxon penetration of England. His book serves a useful purpose in reminding the so-called "Anglo-Saxons" of the Celtic contribution to their life and thought.

Gordon Home's "Roman London" is a reissue of a work, first published in 1925, that has won for itself a deservedly high reputation. A great deal of the area covered by the Roman Londinium, which is outlined by the names that commemorate its entries (Ludgate, Newgate, Aldersgate, Cripplegate, Bishopsgate, and Aldgate), was laid waste by enemy action in the Second World War, so that there are now unique opportunities for excavation and preservation. Major Home, whose artistic skill is evident throughout his book, gives an attractive reconstruction of a part of the Roman wall near Cripplegate, which he suggests might be preserved as a memorial of the origins of the city. The remains of Roman London lie at an average depth of 16 feet below the modern street level, so that archeological excavation has always been difficult and haphazard. Nevertheless, a surprising amount of information has been assembled from casual discoveries, touching even the intimate private life of a population that, on some estimates, reached a maximum of 100,000.

The name Londinium is of Celtic origin, but the most memorable part played by the native British in the early days of London was its destruction by Boudicca (Boadicea) in the revolt of A.D. 60. Although the effective survival of the city through the Dark Ages is open to doubt, the continuity of its site is a major fact in the historical geography of the island.

The Weald is the heart of England's continental angle lying between London and the mainland of Europe, a region destined from early times to receive invasions of men and cultures from the continent. Mr. Margary's intensive field study of "Roman Ways in the Weald" is described by O. G. S. Crawford as "a record of the most important investigation of the Roman roads of England that has ever been undertaken." Mr. Margary distinguishes between the occupation routes that traverse the district between the coast and London and the many local tracks, paved with iron slag, that were constructed to serve the needs of the Wealden iron industry. The most interesting part of his book deals with the modern road and field system at Ripe, near Lewes, which he asserts is an example of the well-known Roman system of centuriation. The regular rectangular layout of roads and fields, the result of planned settlement, is strangely reminiscent of the American Midwest. It has long been recognized that southeastern England has a historical personality as distinctive as its physical geography. The comparatively superficial Anglo-Saxon elements, the presence of Jutes and Franks, and the survival of many Romano-British place names all serve to differentiate it from neighboring regions. The evidence from Ripe strengthens the argument for continuity of schemes of landholding and land use from Roman times and reminds us that the doctrine of "culture-replacement" in Lowland England is subject to reservations.

Mr. Crawford, who contributes a foreword to Mr. Margary's book, is himself the author of "Topography of Roman Scotland." For many years archeological officer of the Ordnance Survey, he is widely known for his contributions to prehistoric geography, for his pioneer work in air photography, and for his editorship of the quarterly *Antiquity*, which he founded in 1927. His new book is the result of many years of field work. It is a fully illustrated account of all known Roman remains in Scotland north of the Antonine wall, that is roughly the Forth-Clyde line as known to geographers. The Roman invasion of Scotland culminated in the seventh and last campaign of Agricola in A.D. 84. The wall itself was built some 60 years later along the line of a series of forts erected by Agricola. The map provided shows that the Roman penetration was confined to the lowlands yet avoided Fife. Although none have been found, Crawford believes that Roman remains will be discovered along the shores of the Moray Firth. Again we find parallels between the ancient and the modern: "The Roman roads and forts of Scotland are exactly comparable to those made there by the English in the eighteenth century." Crawford also compares Scotland and Abyssinia, Agricola and Graziani. A gentle humor conceals a realistic approach to his subject. The tangible results of field work, he confesses, are comparable to the visible portion of an iceberg; but we would add that the weight of what is hidden from the eye gives balance to the whole. His notes on place names (equating, for example, the *law* of the Sidlaws with the English *low*) are a useful addition.

Professor and Mrs. Hawkes have revised and enlarged their Pelican book on "Prehistoric Britain" first published in 1944. Anyone who reads the brilliant prelude with its telling comparisons between the threatened invasion of Britain in 1940 and prehistoric incursions will feel the spirit of the book and be compelled to read on. Its underlying theme is the continuity between the past, present, and future of humanity. It is written by scholars who combine skill in excavation with the ability to interpret the evidence and explain their findings with imagination. The period covered is "from the ape-man to the Anglo-Saxon." Not the least fascinating chapter is that dealing with the evolution of archeological aims in relation to the outlook and opportunities of successive generations, from the shadowy druids of Stukeley to the surface shadows of ancient sites revealed by air photography. A lengthy appendix provides a guide to the outstanding monuments of anitquity in all the major regions of Britain. The visitor with archeological tastes would be well advised to follow this in preference to the inaccurate bits of information likely to be found in the ordinary guidebook.—E. ESTYN EVANS

GÉOGRAPHIE AÉRIENNE. By EMMANUEL DE MARTONNE. 241 pp.; maps, diagrs., ills., bibliogr. (Sciences d'Aujourd'hui). Albin Michel, Paris, 1948. 525 fr. 7½ x 5½ inches.

LA DÉCOUVERTE AÉRIENNE DU MONDE. Edited by PAUL CHOMBART DE LAUWE. 413 pp.; maps, diagrs., ills., bibliogr. Horizons de France, Paris, 1948. 11½ x 8¾ inches.

Aerial photography has long been recognized as of prime importance to the development of cartography. The role of the airplane as an instrument of geographical research, however, has not received much publicity. In two volumes recently published in Paris, the role of aircraft as an outstanding tool of geographical field work is described, and important new vistas are opened up for further contributions in air geography.

Professor de Martonne, in "Géographie aérienne," provides a syllabus of air geography.

Under the headings "Geography of the Atmosphere," "Aerial Cartography," "Aerial Physiography," and "Air Travel," he surveys in a masterly manner the important aspects of the application of aircraft to geographical work. In addition to a short but comprehensive abstract of the geography of the atmosphere, the first section of the book calls attention to the significance of three-dimensional climatology and meteorology, made possible by the wide use of aircraft for the study of weather (cf. hurricane studies made by aircraft in the Caribbean). In the discussion of the state of aerial photogrammetry and aerial surveying in the principal countries of the world, particular emphasis is placed on the development of the several techniques employed and on their adoption by the nations most active in aerial photogrammetry. The chapter on aeronautical charts includes a particularly interesting map of the state of world aeronautical coverage.

Professor de Martonne's use of the term "aerial physiography" is notable for its wide definition; in it he includes discussions not only of morphology, structure, and hydrography but also of vegetational cover, settlement types, land-use patterns, and urban geography. He emphasizes the fact that an aerial photograph is merely one of the tools to be used in a settlement study, side by side with ground surveys, contact with the inhabitants, study of the historical background, and so forth. It is the "aerial landscape" that the geographer is most interested in at first, for an air view permits both a general, overall impression and detailed study at the same time. In this connection, the author mentions with particular praise the works of three "aerial geographers:" Walter Mittelholzer's volumes on the Alps and the Middle East; Dr. Richard U. Light's study of African agriculture and landscapes; and Professor John L. Rich's contribution on South America.

"Géographie aérienne" is also filled with suggestions for the more advanced worker. From the rich storehouse of his experience and knowledge, the dean of French geographers has filled this small volume with that rare treasure, ideas. Whether in the realm of forest management, archeology, land use, rural or urban settlement, the reader will find inspiration as well as information in this volume. A selected bibliography of the more important French, German, English, American, and Russian contributions to the subject is included.

"Découverte aérienne du monde" represents a significant contribution to the study of air geography and to that of geography in general. Hardly another volume since the publication of the late Professor Creutzburg's "Kultur im Spiegel der Landschaft" may be compared to it. But while Creutzburg's great atlas is solely a collection of photographs (many of which are aerial), "Découverte aérienne du monde" is a symposium volume that combines text and air photographs. In this general survey of all major aspects of air geography the contributors discuss the importance of aircraft in the study of physical, human, historical, and even political geography. They make full use of the excellent collection of outstanding air photographs, reprinted from many sources. Consider, for example, the series of three air views of the town of Pont-Saint-Esprit in southern France, taken at decreasing elevations. The first shows the site of the town and the land-use pattern of the region, one of very small farms. In the second the town is shown as a bridgehead, situated above the flood plain, and one can readily see how the main roads and the main streets of the town are connected with each other and with the bridge. In the third, land use, house and field plans, and the stream itself are shown in sufficient detail to permit certain deductions concerning the microgeography of the settlement. Throughout the volume text and photographs are integrated in a remarkable manner.

Among the more interesting and thought-provoking aspects of the book is the number

of suggestions for the further use of aerial views. While many of these are not new, such as the suggestions for aeropelagoscopy, their mention and the emphasis on their use in all branches of geographical work are valuable indeed. In the field of "air political geography" an interesting series of three air photographs on pages 240 and 241 may well become the prototype of similar but more detailed investigations in the future. On these pages three farming areas are shown, two in vertical views, one in a low-altitude oblique view. The first, in the middle Loire Valley of west-central France, brings into relief the extreme fragmentation of the land into many small fields, preventing the efficient use of modern agricultural techniques. The second example, in the Île de France, shows what the author calls a "capitalist solution" of redividing the land and uniting many small fields in a single, big farming unit. The third example, from Denmark, shows the middle course: medium-sized farms, serviced by a farmer cooperative and supporting a relatively prosperous peasantry.

In the field of urban geography the use of air photographs to illustrate the shortcomings of urban planners of the past is of considerable interest. This is illustrated by a series of air photographs of Paris as the basis for a critique of Baron Haussmann's town planning under Napoleon III (pp. 316–321). The use of air photos for the parallel study of primitive and/or native civilizations side by side with those arising from the application of modern industrial techniques is dramatically illustrated by a view of Safi, in Morocco (p. 355). It shows the old Arab town, its flat roofs, individual buildings, and courtyards on one side; on the other, the modern industrial plant and the adjoining community, characterized by broad, straight avenues, planned gardens, sports buildings, and community centers.

One of the most valuable sections of the book is the final one, dealing with "technical details." It discusses various types of aircraft suitable for purposes of aerial photography and reconnaissance; aerial cameras and their characteristics; the techniques of aerial photography, photogrammetry, and surveying; the role of aircraft in exploration and in the study of meteorological phenomena, aerial magnetism, and cosmic rays; and the technique of interpreting an air photograph. In six pages, using air photographs, maps, and diagrams, the author, M. Chombart de Lauwe, anthropologist at the Paris Anthropological Museum, gives an excellent outline of the various angles from which an air photograph should be considered. Geographers would do well to contemplate his outline, as would geologists, archeologists, historians, and others concerned with the study of human life on our planet.

The two volumes here discussed bring a refreshingly new note into the field of geographical literature. The authors display a knowledge of their subject and of all its ramifications that is truly impressive. More than that, while much of what they discuss is not new, they do not hesitate to bring in new techniques. They do not use illustrations merely to beautify their books: the photographs, maps, and sketches are an integral part of the text, constantly referred to and indispensable to the reader.—George Kish

GENERAL CARTOGRAPHY. By Erwin Raisz. 2nd edit. xv and 354 pp.; maps, diagrs., ills., bibliogr., index. (McGraw-Hill Series in Geography.) McGraw-Hill Book Co., New York, Toronto, London, 1948. $6.00. 10 x 7¼ inches.

The appearance of the first edition of this work 11 years ago was characterized (*Geogr. Rev.*, Vol. 29, 1939, pp. 699–701) as one evidence of the maturity that American geography had attained. The publication of this second edition testifies to the enduring worth of the book as well as to the intensified demand created by the enormous advance that American cartography made during World War II.

Physically, the format has been increased somewhat, and the text has been entirely reset in two columns to the page, with side headings in boldface type, both of which features add to the legibility and synoptical quality of the reading matter. As to content, some chapters have been merged, others have been rearranged, and one has been relegated to the appendix—all in the interest of a firmer organization of the material.

One whole "Part," consisting of four chapters, on "Surveying on the Ground and from the Air," has been added. In the same manner as the rest of the book, this is concisely written and covers all essentials and yet supplies a large number of specific, significant details. This part, and particularly its last two chapters, "Aerosurveying" and "Airplane Photo Interpretation," enables the author to discuss briefly the new techniques developed during the war, such as those represented by shoran and loran charts, by trimetrogon surveying, and by the use of the multiplex projector. In addition, there is a chapter on "Cartography in War," in which, and elsewhere throughout the book, the new developments, including the rollable rubber relief models, are further described.

The section on the topographic series of the national surveys of the world, presented in the first edition on the basis of data furnished by the American Geographical Society, has been omitted because, as the author validly says (p. 209): "The Army Map Service and other government agencies [now] supply a rich coverage of foreign countries, which satisfies the map demands of American colleges, and therefore it is seldom necessary to go to the original sources." For those who nevertheless want a synopsis of these series, Olson and Whitmarsh's "Foreign Maps," New York, 1944 (reviewed in the *Geogr. Rev.*, Vol. 34, 1944, pp. 675–676), although somewhat uneven in treatment (*Surveying and Mapping*, Vol. 5, No. 2, 1945, pp. 54–55), affords a rapid overview.

In the chapter on cartography in the war the outstanding achievements of the Army Map Service and other war-created mapping agencies are set forth. But unfortunately these up-to-date data are not utilized in the description of the leading mapping agencies of the United States government in Chapter 21. This description is attributed to the Map Information Office of the Federal Board of Surveys and Maps, yet the Board has not been in existence since March, 1942, six years before the date (May, 1948) of the author's preface. The Map Information Office, revitalized in January, 1946, continues as a unit of the United States Geological Survey. The author would have been well advised, as he was in the case of the Board on Geographic Names with regard to its work, to have had the Map Information Office revise the description, particularly since a yearly survey of the work of the federal mapping agencies, begun with the report on 1946, which appeared in the spring of 1947, is now one of its regular tasks (these are issued in mimeographed form and then printed in the *American Year Book*). The obsoleteness of this section of the work under review is therefore not ascribable to the present Map Information Office.

The four chapters on the history of cartography at the beginning of the book, although practically unchanged in the new edition, perhaps again merit brief mention in conclusion. Written in the concise and informed style to which reference has been made, they provide an excellent survey of the development of geographic knowledge as reflected in maps, familiarity with which knowledge constitutes a *sine qua non* for every professional geographer. The history of American cartography (Chapter 4), which, when it first appeared, represented a pioneer undertaking carried out with hardly a precedent for guidance, remains, in the opinion of the reviewer after 12 years of contact with many of the orginal documents in that domain at the National Archives, the best overall presentation of this fascinating and still almost untrodden field.—W. L. G. JOERG